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METHOD OF APPLICATION OF DRUGS TO THE NASAL MUCOSA

A COMPARISON OF NASAL DROPS, SPRAYS AND INHALERS

DONALD B. BUTLER, M.S.

AND

ANDREW C. IVY, M.D.

CHICAGO

INTRODUCTION

The choice of drugs for use in rhinologic practice has occupied much of the literature of rhinology, but the question of the most desirable method of administration has been the source of only limited investigation.

The purpose of any method of administration is to apply the therapeutic agent to as large an area of the nasal mucosa as possible with a minimum of trauma or damage. Ease of administration and adaptation to self medication are important secondary considerations.

In any comparison of different methods of application of drugs to the nasal mucosa some drug must be sought that will lend itself to all methods of administration being studied. Thus an investigation of the use of nasal drops, nasal sprays and volatile inhalers requires an agent that can be used either in solution or in volatile form.

Certain of the synthetic vasoconstrictor amines lend themselves admirably to this requirement. The use of vasoconstrictors also has the advantage of ease of measurement of the effectiveness of the drug. The degree of vasoconstriction can be measured quantitatively in the laboratory by one of several methods.[1] The administration of vasoconstrictor drugs forms a large bulk of rhinologic therapy, and the choice of a drug from this group is thus especially desirable.

From the Department of Physiology, Northwestern University Medical School.

This research has been aided by a grant from the Clara A. Abbott Fund of Northwestern University.

1. (*a*) Zwaardemaker, H., and Reuter, C.: Athembeschlag als Hülfsmittel zur Diagnose der nasalen Stenose, Arch. f. Laryng. u. Rhin. **1**:174, 1893. (*b*) Sternberg, H.: Beiträge zur Physiologie und Pathologie der Schleimhart der Luftwage, Ztschr. f. Hals-, Nasen- u. Ohrenh. **12**:340 (May) 1925. (*c*) Dufton, A. F., and Bedford, T.: "Nose-Opening" Rays, J. Hyg. **33**:476 (Nov.) 1933. (*d*) O'Malley, J. F.: Ventilation of the Nose and Accessory Sinuses, J. Laryng. & Otol. **48**:309 (May) 1933. (*e*) Bernheimer, L. B.: Color Index of the Nasal Septum, Arch. Otolaryng. **20**:31 (July) 1934. (*f*) van Dishoeck, H. A. E.: Infra-Red Radiation and Nasal Obstruction, J. Hyg. **35**:185 (May) 1935. (*g*) Hill, L.: A Method of Measuring the Airway of the Nose, Lancet **2**:70 (July 13) 1935. (*h*) Spiesman, I. G.: Vasomotor Responses of the Mucosa of the Upper Respiratory Tract to Thermal Stimuli, Am. J. Physiol. **115**:181 (March) 1936. (*i*) Sternstein, H. J., and Schur, M. O.: Quantitative Study of Nasal Obstruction: A New Method, Arch. Otolaryng. **23**:475 (April) 1936. (*j*) Hertzman, A. B.: Photoelectric Plethysmography of the Nasal Septum in Man, Proc. Soc. Exper. Biol. & Med. **37**:290 (Nov.) 1937. (*k*) Silcox, L. E.: Rhinitis: A Nasographic Study, Arch. Otolaryng. **34**:33 (July) 1941.

HISTORICAL REVIEW

Comparative studies of methods of administration of drugs to the nasal mucosa have been few. Henderson, Beach and Johnston [2] made an interesting study of the effectiveness of nasal sprays and nasal drops in reaching the remote areas of the nasal mucosa. They used a suspension of lamp black in liquid petrolatum U. S. P. and estimated the areas covered by direct observation through the nasopharyngoscope in the previously cocainized nose.

The spray, applied with a DeVilbiss atomizer having an olive tip, reached most of the lower meatus, the anterior end of the middle meatus and the lower turbinate when the atomizer was held horizontally. If the olive tip was removed and the atomizer moved around while spraying, much of the middle turbinate was also reached by the spray.

When a medicine dropper was used and the head was bent well backward and forward and rolled from side to side, "the whole nasal area that could be viewed with the nasopharyngoscope was covered."

Proetz [3] expressed the opinion that the use of nasal drops is an effective method of applying drugs. He suggested that the head be inverted and the drops spread throughout the nasal cavity by gravity. Gompertz and Michael,[4] however, recently pointed to the nose drop bottle as a source of contamination and spread of infections from person to person.

The use of volatile vasoconstrictors in the form of nasal inhalers was first reported by Bertolet in 1932.[5] Many reports on the use of nasal inhalers have since appeared.[6]

Proetz [7] investigated the effects of volatile amphetamine (Benzedrine Inhaler [8]) on the ciliary activity of the nasal mucosa and concluded that the volatile drug had caused no changes in ciliary activity after twenty minutes' application.

Scarano [6b] studied the secondary reactions following prolonged use of 1 per cent ephedrine in liquid petrolatum, 1 per cent amphetamine in liquid petrolatum and volatile amphetamine (Benzedrine Inhaler). The occurrence of untoward reactions was considerably less marked after one week's use of the amphetamine solution than after a like period of use of the ephedrine solution. The reactions following the use of the inhaler were so slight as to be considered negligible.

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2. Henderson, V. E.; Beach, M. L., and Johnston, J. F. A.: On the Use of Nasal Sprays and Drops, Canad. M. A. J. **24**:684 (May) 1931.

3. Proetz, A. W.: Essays on the Applied Physiology of the Nose, St. Louis, Annals Publishing Company, 1941.

4. Gompertz, J. L., and Michael, P.: Nose Drop Contamination in Dropper Bottles, J. A. M. A. **118**:1287 (April 11) 1942.

5. Bertolet, J. A.: Benzyl Methyl Carbinamine Carbonate, M. J. & Rec. **136**:75 (July 20) 1932.

6. (*a*) Byrne, H. V.: The Use of Benzyl-Methyl-Carbinamine-Carbonate in the Treatment of Rhinitis, New England J. Med. **209**:1048 (Nov. 23) 1933. (*b*) Scarano, J. A.: Rapidity of Shrinkage and Immediate and Secondary Reactions Following Local Applications of Ephedrine and Benzedrine: A Comparative Study, M. Rec. **140**:602 (Dec. 5) 1934. (*c*) Giordano, A. A. S.: Benzyl Methyl Carbinamine (Benzedrine), Pennsylvania M. J. **39**:20 (Oct.) 1935. (*d*) Sulman, L. D.: Certain Conditions in Which a Volatile Vasoconstrictor Has Proved of Particular Value: A Preliminary Report, M. Times & Long Island M. J. **63**:374 (Dec.) 1935. (*e*) Scarano, J. A.: The Gross Changes Produced in the Nose by Benzedrine Inhalation: An Analysis of One Hundred Cases, M. Rec. **143**:161 (Feb.) 1936. (*f*) Scarano, J. A., and Coppolino, J. F.: The Use of Benzedrine Vapor in Children, Arch. Pediat. **54**:97 (Jan.) 1937. (*g*) Bertolet, J. A.: Benzedrine in Paranasal Sinusitis, Clin. Med. & Surg. **44**:25 (Jan.) 1937.

7. Proetz, A. W.: Applied Physiology of the Nose and the Accessory Nasal Sinuses, Am. J. Surg. **42**:190 (Oct.) 1938.

8. The term Benzedrine Inhaler is the trade-marked name for a commercial inhaler containing amphetamine, menthol and oil of lavender manufactured by Smith, Kline and French Laboratories.

Giordano [6c] compared the duration of vasoconstriction following the use of 1 per cent amphetamine in oil in the form of a nasal spray with the duration of response following the use of volatile amphetamine (Benzedrine Inhaler). He made clinical observations on 64 patients with various rhinologic infections and examined the nose at one or two minute intervals until the effect of the drug disappeared. He concluded that the amphetamine spray was effective for one hundred nine and a half minutes while the inhaler was effective for one hundred and eight minutes. A 1 per cent ephedrine solution in oil was effective for ninety-two minutes.

Secondary reactions to toxic doses of volatile amphetamine were studied by Ward [9] in a series of eight experiments in which only a single subject was used. The subject inhaled from two fresh inhalers simultaneously for periods of four to six hours continuously, exhaling through the oral cavity. Ward estimated that between 400 and 500 mg. of the drug was absorbed (approximately one thousand times the normal rhinologic dose). He found that this dose caused an elevation of the blood pressure, dehydration, anorexia, loss of 10 to 14 pounds (4.5 to 6.5 Kg.) in weight and marked stimulation of the central nervous system.

Peters and Faulkner [10] observed 67 subjects for effects of large doses of volatile amphetamine. They found no significant changes in the blood pressure or the pulse and only slight alterations in the electrocardiogram.

Dyer [11] studied the effects of twenty rapid inhalations of volatile amphetamine in 20 normal subjects. He reported no change in the majority of the subjects. Four of them had a rise in blood pressure of as much as 10 mm. of mercury. One subject had a fall in blood pressure of 15 mm. of mercury,

Sternstein [12] recently reported the results of objective studies of several nasal sprays and volatile amphetamine (Benzedrine Inhaler) in both obstructed and nonobstructed noses. He measured effectiveness by a quantitative study of vasoconstriction (see a later paragraph). He found the inhaler more effective than many of the sprays in the nonobstructed nose, but in acute infections of the upper respiratory tract the inhaler caused less prolonged vasoconstriction than did 1 per cent ephedrine. The inhaler was more effective than any of the sprays in subacute infections of the upper respiratory tract and also in vasomotor rhinitis.

In discussing the loss of effectiveness of the volatile drug in acute rhinitis Sternstein concluded: "The most likely explanation for the diminished effect of amphetamine is the decreased permeability of the mucous membrane in the presence of an acute inflammatory exudative process, with the result that a volatile drug fails to stimulate the peripheral vasomotor mechanism with the same intensity as a freely miscible shrinking solution." (See a later paragraph.)

The effects of prolonged use of various drugs have been studied by Fox [13] and Hunnicutt.[14] Hunnicutt reported that an amphetamine solution used three times daily for ten days produced mild inflammation and moderate purulent exudation

9. Ward, S. P.: The Effect of Toxic Doses of Benzyl Methyl Carbinamine (Benzedrine) in Man, J. A. M. A. **110**:206 (Jan. 15) 1938.

10. Peters, C. M., and Faulkner, J. M.: Circulatory Effects of Volatile Amphetamine (Benzedrine Inhaler), Am. J. M. Sc. **198**:104 (July) 1939.

11. Dyer, W. W.: Pressor Effect of Amphetamine ("Benzedrine") on Normal, Hypotensive, and Hypertensive Patients, Am. J. M. Sc. **197**:103 (Jan.) 1939.

12. Sternstein, H. J.: Efficacy of Vasoconstrictor Agents in the Obstructed Nose: A Quantitative Evaluation, Arch. Otolaryng. **36**:713 (Nov.) 1942.

13. Fox, N.: The Chronic Effect of Epinephrine and Ephedrine on the Nasal Mucosa, Arch. Otolaryng. **13**:73 (Jan.) 1931.

14. Hunnicutt, L. G.: The Effect of Drugs on the Nasal Mucous Membrane, Tr. Pacific Coast Oto-Ophth. Soc. **26**:51 (May) 1941.

in mice, while an amphetamine inhaler used six times daily for ten days produced only very mild inflammatory reaction in the form of mucous droplets and no purulent exudate.

METHOD OF STUDY

Choice of Drug and Dosage.—For the purposes of the present study a vasoconstrictor agent was required which could be administered as nasal drops, a nasal spray or a nasal inhalant. The synthetic amine desoxyephedrine meets these requirements and was selected for study.[15] The racemic form was used throughout.

The nasal inhaler was prepared by placing 0.25 cc. of d,l-desoxyephedrine on the cotton cartridge of an inhaler of standard size and shape. No perfumes or fixing agents were added, as it has been shown that the effectiveness of a volatile vasoconstrictor may be markedly altered by the presence of other volatile substances.[16]

The inhaler output was measured by the method of Tabern.[17] The inhalers used in this study released 0.968 mg. of drug per liter of air inhaled through the cartridge.

The average inhalations of the subjects of these experiments were determined by attachment of an inhaler to a spirometer. Four deep inhalations averaged 3.3 liters of air. Thus it could be calculated that the dose of drug administered by four deep inhalations was approximately 3.19 mg. of the drug.

It was found that the volume output of a large DeVilbiss atomizer was 0.0806 cc. per spray. If a 1 per cent solution was used the drug output would be 0.806 mg. per spray or 3.22 mg. for four sprays.

A medicine dropper of standard size yielded 0.042017 cc. per drop. Thus a 1 per cent solution gave 0.42017 mg. per drop or 3.36 mg. from eight drops.

The 1 per cent solutions used for drops and sprays contained d,l-desoxyephedrine hydrochloride in distilled water. The difference in molecular weight between the pure base and the hydrochloride is so slight that it can be neglected in our foregoing calculations.

The use of the base in the inhaler and the nonvolatile salt in the drops and sprays was necessitated by the fact that a constant solution of the pure base cannot be kept, as it loses potency rapidly owing to the volatility of the drug. The active portion of the desoxyephedrine molecule remains unchanged in the hydrochloride. The hydrochloride solution has a p_H of 6 to 7.

Efficacy of Vasoconstriction.—In the study of the efficacy of different methods of applying vasoconstrictor drugs to the nasal mucosa the amount of vasoconstriction becomes a yardstick for the quantitative measurement of the efficiency of the method in question. By applying the same drug in identical amounts by different methods, one is able to determine the relative value of each method studied and to come to some conclusions regarding its clinical efficacy.

The vascular structure of the nasal tissues is unusual in that it is composed of a superficial capillary layer and a deeper submucosal layer of large erectile sinuses. Sternberg[18] and Burnham[19] have both pointed out that these two venous plexuses may undergo vasoconstriction either independently or simultaneously. In acute rhinitis, vasodilation of the superficial capillary layer results in the characteristic mucosal hyperemia, and vasodilation of the deeper erectile sinuses results in swelling of the turbinates and obstruction of the nasal airway.

The purpose of using vasoconstrictor agents in rhinologic practice is to cause shrinkage of the swollen turbinates in order to provide a clear airway. The hyperemia of the mucosa probably serves the same important functions that hyperemia serves in any inflammatory process in the body. Burnham[19] has shown that certain drugs may cause constriction of the two systems simultaneously (epinephrine) or may cause shrinkage of the turbinates with little or no effect on the mucosal capillaries (ephedrine).

Since vasoconstriction of the peripheral vascular layer is not a desirable feature in therapy, any methods of study based on the hyperemia of the mucosa[16] or the temperature of the mucosa[1h] are of no value in this particular study. A method of study must be chosen that measures the degree of vasoconstriction occurring in the deep erectile layers of the nasal tissues.

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15. The inhalers and solutions used in this study were furnished by Dr. D. L. Tabern, of Abbott Laboratories.

16. Butler, D. B., and Ivy, A. C.: Effects of Nasal Inhalers on Erectile Tissues of the Nose: Quantitative Studies, Arch. Otolaryng. **38**:309 (Oct.) 1943.

17. Tabern, D. L.: Personal communication to the authors.

18. Sternberg, H.: Pharmacologic Reactions in the Erectile Tissue and Subepithelial Net of Capillaries in the Nose: Vasomotor Nerve Supply of this Vascular System, Monatschr. f. Ohrenh. **63**:390 (April) 1929.

19. Burnham, H. H.: Some Differences in the Action of Ephedrine and Epinephrine (Adrenalin, etc.) on the Nasal Turbinate Mucosa, Canad. M. A. J. **27**:168 (Aug.) 1932.

The measurement of nasal obstruction by determining the resistance of the nasal passage to the flow of a stream of air was first described by van Dishoeck.[1f] He used an inclined draft gage and a pump blowing a stream of air into the nose. Any resistance by the nasal passages to the flow of the air stream produced an increase in the draft gage reading. He concluded on theoretic grounds that studies of change in the intranasal volume required subjects with anatomic defects causing "a nasal airway of about 50 mm.[2] (that is, equal to or smaller than the normal cross-section of the internal ostium)" and that normal nasal passages were not suitable for study. This conclusion has since proved fallacious, as Sternstein [20] and Butler and Ivy [16] have demonstrated changes in nasal obstruction due to various chemical and physical agents in normal subjects with no anatomic defects present. Van Dishoeck neglected to consider the important factor of turbulent flow of the air stream through the nasal passage in making his calculations.

Sternstein and Schur [11] used the same physical principles as van Dishoeck but replaced the positive air stream with a suction system. They have developed a simple and reliable method for measuring changes in nasal obstruction.

The study of changes in nasal obstruction in the present experiments was conducted with a method modified from that of Sternstein and Schur [11] (fig. 1). The instrument used consists of an electric suction pump attached to a gas flow meter and an inclined draft gage. The suction tube is attached to a nasal olive tip. A constant amount of suction is maintained by the pump and is adjusted until the air flow is 7.3 liters per minute as measured by the

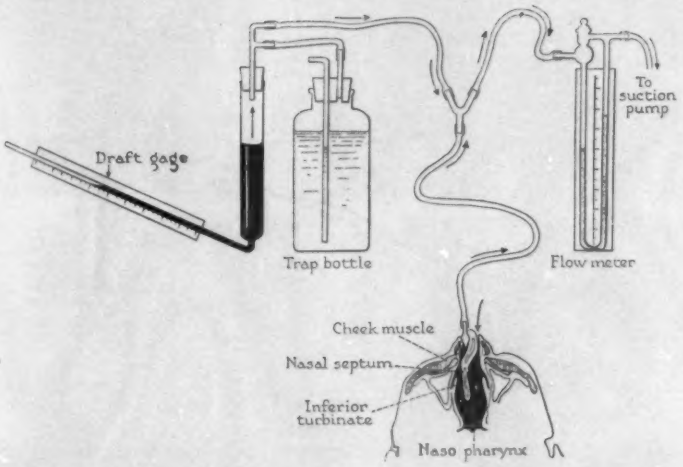

Fig. 1.—Method for measuring nasal obstruction, a modification of the method described by Sternstein and Schur.[11]

flow meter. Any resistance placed over the nasal tip, as by an obstructed nose, is indicated by a fall in the level of the draft gage. Thus any change in the degree of nasal obstruction will be indicated by a change in the draft gage reading.

Each subject was trained to sit in front of a mirror and insert the nasal tip into one nostril, closing the mouth tightly and holding the breath until a reading was made. The path of the air flow is into one nostril, through the nasal passages of that side, through the nasopharynx into the posterior choanae of the opposite nostril and thence through the nasal passages of that side and into the nasal tip (fig. 1).

Two readings were taken with the nasal tip in one nostril and then two were taken with the nasal tip in the opposite nostril. The four readings were averaged and the average recorded as the relative value for the nasal resistance to air flow.

In every experiment the nasal resistance of each subject was measured before any drug was administered. After administration of the drug the nasal resistance was measured at carefully timed intervals. Thus a reading was taken at one minute, five minutes, fifteen minutes, thirty minutes and thereafter at thirty minute intervals until the nasal resistance again approached or returned to normal.

20. Sternstein, H. J.: Quantitative Effects of Physical and Chemical Agents on the Erectile Tissue Response in the Nose, Arch. Otolaryng. **34**:523 (Sept.) 1941; footnote 12.

Methods of Application.—The methods of application studied were nasal drops, nasal sprays and nasal inhalers. The nasal drops were administered by having the subject tilt his head well back and inserting 8 drops of the 1 per cent solution into the nostrils, 4 drops to each side. The subject held his head in the inclined position for thirty to forty seconds and then resumed a normal posture.

The nasal spray was administered by placing the tip of a large DeVilbiss atomizer (no olive tip) well into the nasal vestibule and holding the atomizer in the horizontal position. Four sprays were administered, two to each side. The subject held his head in the inclined position for thirty to forty seconds and then resumed a normal posture.

The nasal inhaler was administered by the subject taking four deep inhalations, two inhalations into each nostril, from an inhaler of standard size and shape containing the drug being studied.

Nine young adult males with no demonstrable pathologic condition were used as the subjects for these experiments. The presence of any nasal inflammation or abnormal obstruction contraindicated the use of that particular subject until the condition had entirely disappeared.

Effects of Prolonged Administration.—The effects of prolonged medication with nasal drops, nasal sprays and nasal inhalers of vasoconstrictor amines were studied in a series of experiments on normal adult rabbits.

The drug was applied to only the left nasal passage of each animal, the right side serving as a blank control.

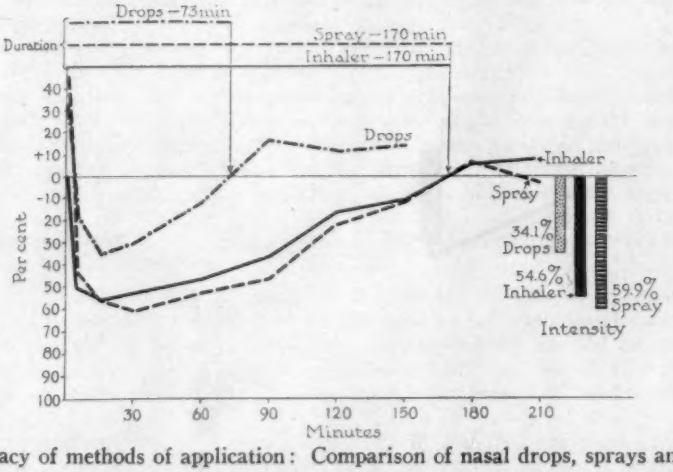

Fig. 2.—Efficacy of methods of application: Comparison of nasal drops, sprays and inhalers.

Drops—3.36 mg. of d,l-desoxyephedrine hydrochloride (27 trials on 9 subjects)

Spray—3.22 mg. of d,l-desoxyephedrine hydrochloride (27 trials on 9 subjects)

Inhaler—3.19 mg. of d,l-desoxyephedrine (27 trials on 9 subjects)

The nasal drops were administered from a standard dropper of the same type as that used in the human experiments. Four drops of a 1 per cent aqueous solution of the hydrochloride were administered once daily.

The nasal spray was administered from a nasal atomizer, and two sprays of 1 per cent solution were administered once daily.

The nasal inhalant was administered by placing the inhaler cartridge in a glass adapter tube which fitted into the nostril of a rabbit. The adapter was fitted with a large rubber syringe bulb. Four squeezes of the bulb constituted an application, and this was repeated three times daily.

A total of 24 rabbits were treated: 8 with drops, 8 with sprays and 8 with inhalers. Four animals from each group were killed after thirty days' treatment, and the remaining 4 animals from each group were killed after ninety days' treatment.

Half of the animals were treated with d,l-desoxyephedrine and the other half with d,l-amphetamine, so that the effects of the two similar vasoconstrictor drugs could be compared. The similarity of the vasoconstrictor properties of these two drugs has been described in previous studies,[16] but no comparative studies of the effects on the nasal mucosa of prolonged administration of these drugs have yet been reported.

The animals were killed by intravenous injection of pentobarbital sodium. The nasal septum was carefully removed with the mucosa from both the control and the treated side intact.

The septums were fixed in Bouin's solution and paraffin sections prepared for histologic study. Both hematoxylin-eosin and Van Gieson stains were used.

One dog was treated with a d,1-amphetamine inhaler for one hundred and eighty days.

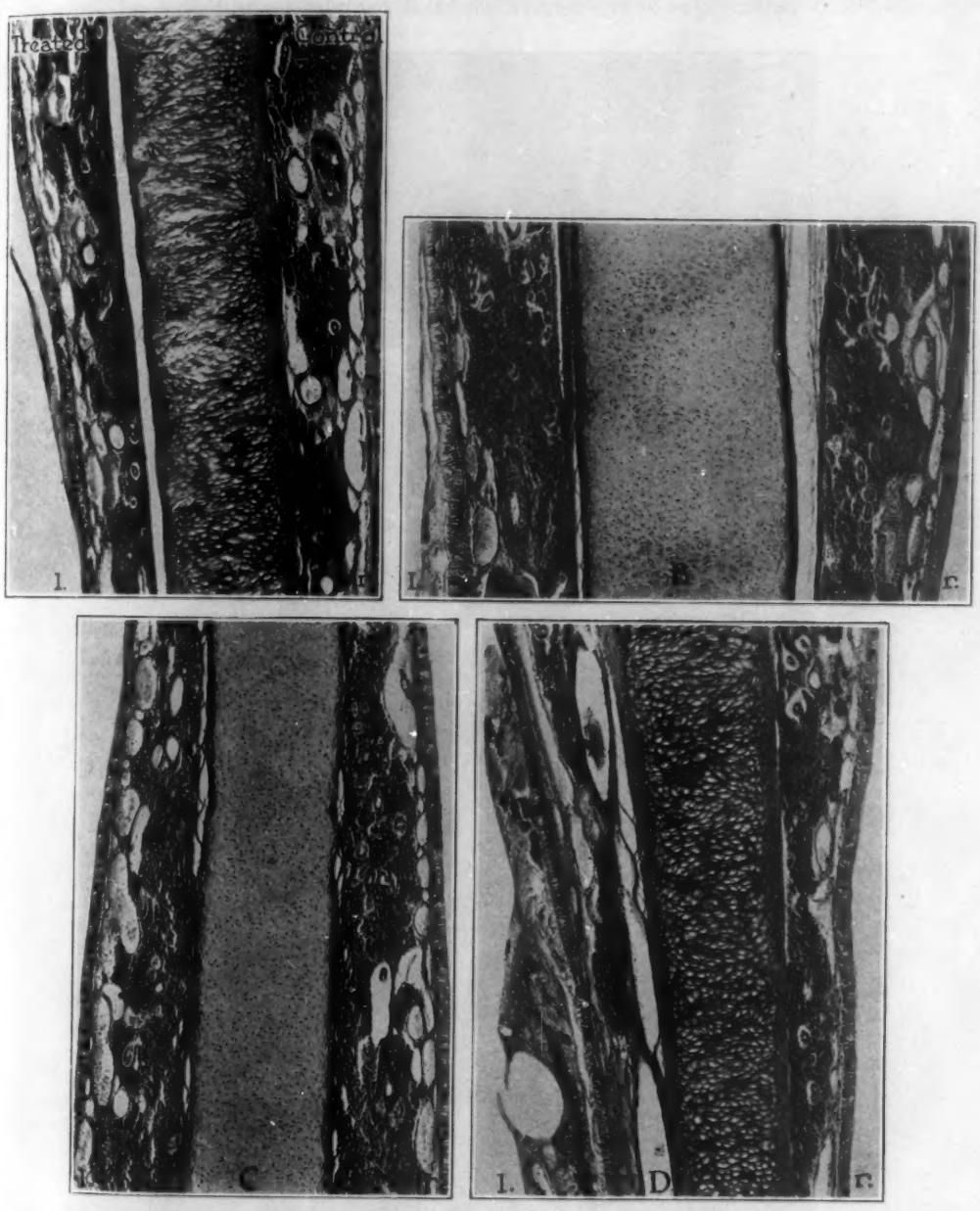

Fig. 3.—Effects of prolonged use of nasal inhalers: *A*, d,1-desoxyephedrine inhaler, used for thirty days. *B*, d,1-desoxyephedrine inhaler, used for ninety days. *C*, d,1-amphetamine inhaler, used for thirty days. *D*, d,1-amphetamine inhaler, used for ninety days.

RESULTS

Efficacy of Vasoconstriction.—A series of eighty-one experiments was conducted on 9 normal male subjects. Nine trials were made with each subject: three

trials with nasal drops, three trials with nasal spray and three trials with the nasal inhaler.

The nasal resistances as measured by the method previously described have been computed as percentages of the normal or basal reading, made before administra-

Fig. 4.—Effects of prolonged use of nasal inhalers in a dog; d,l-amphetamine inhaler was used for one hundred and eighty days.

tion of the drug. The percentage results of all experiments with the same method of application have been averaged, and the final average response is shown graphically in figure 2.

Zero per cent on the graph represents the basal nasal resistance before medication, and any fall below that level is indicative of a fall in nasal resistance due to vasoconstriction of the nasal erectile tissue. Any rise above the base line is indicative of an increase in nasal congestion and vasodilation.

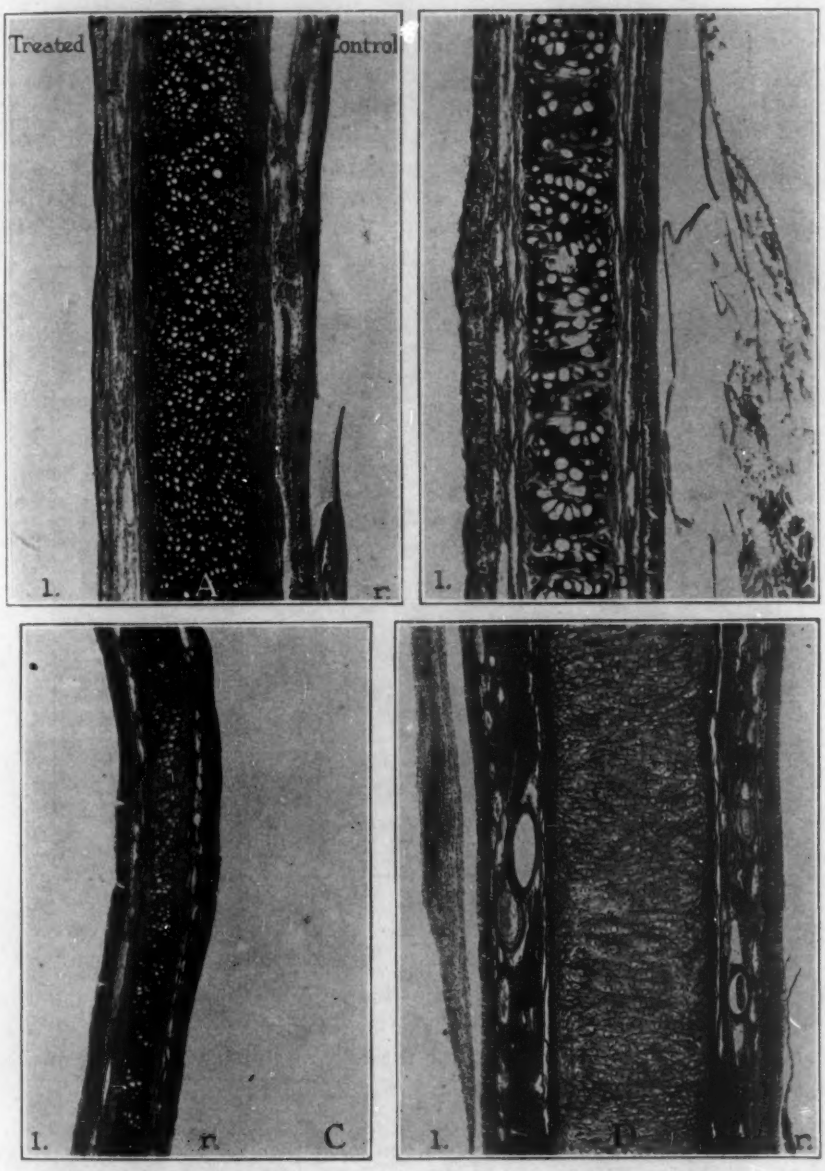

Fig. 5.—Effects of prolonged use of nasal sprays: *A*, d,l-desoxyephedrine hydrochloride spray, used for thirty days. *B*, d,l-desoxyephedrine hydrochloride spray, used for ninety days. *C*, d,l-amphetamine hydrochloride spray, used for thirty days. *D*, d,l-amphetamine hydrochloride spray, used for ninety days.

The administration of d,l-desoxyephedrine in the form of nasal drops resulted in an initial rise in nasal resistance of 32.0 per cent within one minute and a rapid fall to the point of maximum vasoconstriction fifteen minutes after administration

of the drug. Medication by nasal drops caused a fall in nasal resistance to — 34.1 per cent. The vasoconstrictor effect lasted for seventy-three minutes.

The use of nasal spray also resulted in an initial rise in nasal resistance (45.1 per cent) within one minute followed by a fall of resistance to the point of maximum effect within fifteen to thirty minutes. The maximum degree of vasoconstriction resulted in average nasal resistance of — 59.9 per cent. The vasoconstrictor effect lasted for one hundred and seventy minutes.

The nasal inhalers used did not cause an initial rise in nasal resistance. The resistance rapidly fell to — 54.6 per cent within fifteen minutes. The duration of effect was one hundred and seventy minutes, the same as for the nasal spray.

After-congestion following the vasoconstriction was measured for an hour after the vasoconstrictor action was gone. It is evident from the graph that the nasal drops caused more marked after-congestion than did the spray or the inhaler.

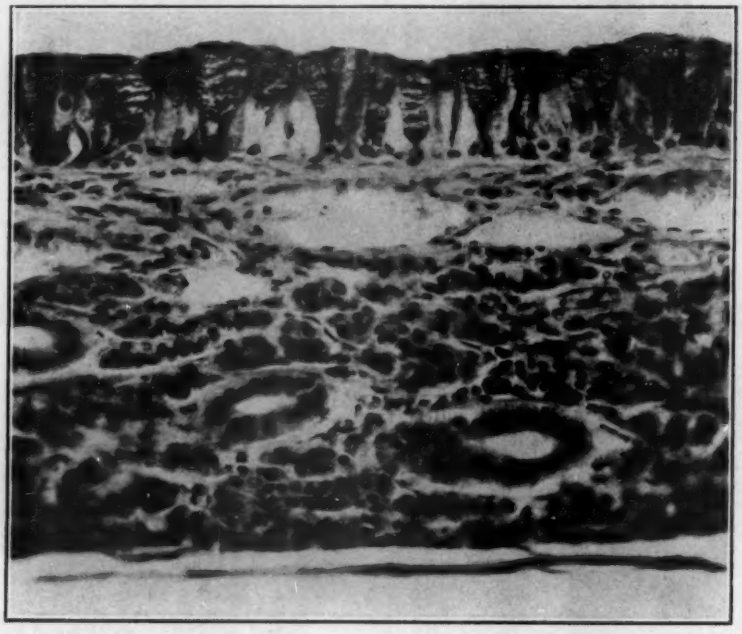

Fig. 6.—Effects of using d,l-amphetamine hydrochloride spray for ninety days. Note the marked increase in Goblet cells.

Effects of Prolonged Administration.—The effects of prolonged administration of d,l-desoxyephedrine as a volatile inhaler are shown in figure 3 *A* and *B*. No change occurred in the nasal mucosa at the end of thirty days. The ninety day rabbits showed slight changes in the mucosa. A few small areas of early metaplasia were present.

The d,l-amphetamine inhaler (fig. 3 *C* and *D*) produced an increase in Goblet cells in thirty days. There were a few regions of low cuboidal and squamous epithelium where early metaplasia had occurred. After ninety days' treatment the mucosa showed slightly more metaplasia but was still essentially normal throughout. There was a thick mucopurulent exudate on the mucosal surface. The submucosa had undergone slight fibrosis, and the subepithelial vessels were dilated. Treatment continued for one hundred and eighty days in a dog caused no change in the nasal mucosa (fig. 4).

Thirty days' treatment with desoxyephedrine spray (fig. 5 *A* and *B*) produced some slight areas of metaplasia. Treatment for ninety days produced more definite areas of stratified squamous elements between regions of normal respiratory epithelium. The submucosa showed no definite changes.

Fig. 7.—Effects of prolonged use of nasal drops: *A*, d,l-desoxyephedrine hydrochloride drops, used for thirty days. *B*, d,l-desoxyephedrine hydrochloride drops, used for ninety days. *C*, d,l-amphetamine hydrochloride drops, used for thirty days. *D*, d,l-amphetamine hydrochloride drops, used for ninety days.

Amphetamine spray (fig. 5 *C* and *D*) produced slight changes after thirty days' treatment, the mucosa containing many more goblet cells than the untreated mucosa. After ninety days the epithelium showed small areas of metaplasia to

low cuboidal and squamous types of epithelium and a marked increase in actively secreting goblet cells (fig. 6). The vessels of the submucosa were slightly dilated, and there was some mucopurulent discharge on the mucosal surface.

Desoxyephedrine drops produced rather marked pathologic changes in the nasal mucosa (fig. 7 *A* and *B*). After thirty days the epithelium had become stratified

Fig. 8.—Effects of using d,l-desoxyephedrine hydrochloride drops for ninety days. Note the subepithelial abscess draining onto the mucosal surface.

in some areas and was entirely absent in other regions. A purulent exudate was present. The submucosal tissue had undergone fibrosis, and the subepithelial vessels were dilated and engorged. Ninety days' treatment produced multiple subepithelial abscesses and regions of complete denudation. A thick purulent exudate was present. Figure 8 shows one such abscess draining onto the mucosal surface.

Amphetamine drops also produced marked changes in the nasal mucosa (fig. *7 C* and *D*). After thirty days the mucosa had become metaplastic, with some denudation of the surface. The epithelial layer contained many leukocytes infiltrating onto the mucosal surface. Subepithelial fibrosis had occurred, and the submucosal vessels were dilated. Ninety days' treatment caused an exaggeration of the pathologic changes seen after thirty days.

COMMENT

The results described indicate that the nasal spray and the inhaler are more efficient for the application of vasoconstrictor drugs to the normal nose than are nasal drops.

Henderson, Beach and Johnston [2] found nasal drops more efficient than sprays in their studies, but there are several particulars in which their experimental methods differed from the methods used in the present work. They used a heavy suspension of lamp black in liquid petrolatum, which differs greatly in density from the aqueous solution used in the present experiments. Moreover, Henderson and co-workers had their subjects rotate the head in all directions in order to spread the oil. In the present studies we have confined our method to simple extension of the head backward for forty seconds.

It is quite probable that nasal drops administered by the more elaborate procedures described by Henderson, Beach and Johnson,[2] Proetz [3] or Parkinson [21] may result in a greater efficiency of this method and cause a greater degree of vasoconstriction for a more prolonged period. The present study has been confined to a comparison of drops, sprays and inhalers in their simplest forms as used by the laity in self medication.

Giordano [6c] compared the effects of amphetamine administered as a spray of a 1 per cent solution in oil with the effects of a commercial amphetamine inhaler. He studied the clinical and subjective effects in 64 cases of mixed types of rhinologic infections. He found that the spray was effective for an average of one hundred and nine and one-half minutes and the inhaler for one hundred and eight minutes. He concluded that a spray of amphetamine in oil and an amphetamine inhaler are equally effective in cases of rhinitis. These results compare favorably with the results of our studies of sprays and inhalers as used in normal subjects.

Sternstein [12] likewise studied the effects of nasal sprays and inhalers on patients with rhinologic infections. He used a method similar to the one used in the present study. He divided his patients into several groups according to the pathologic conditions found: air passages nonobstructed but with underlying disease; acute infection of the upper respiratory tract with obstruction; subacute infection of the upper respiratory tract with obsrtuction; vasomotor rhinitis with obstruction. He found the inhaler effective in the patients with nonobstructed airways and very effective in those with subacute infection but of less value in those with acute rhinitis. He suggests that decreased effectiveness of the inhaler is due to altered permeability of the acutely inflamed mucosa.

It seems likely that the effect of nasal obstruction on the dose of drug that can be administered by the inhaler may play an important role in the decreased effectiveness in the presence of acute rhinitis in Sternstein's studies. The nasal spray is administered in constant dose by external pressure spray, but the nasal inhaler depends on inspiratory air flow for administration, and any decrease in

21. Parkinson, S. N.: A Lateral Head-Low Position for Nasal and Sinus Treatment, Arch. Otolaryng. **17:787 (June) 1931.**

inspiratory air flow, as occurs in severe obstruction, will result in a marked decrease in the amount of drug administered.

The transient vasodilatation that occurred within one minute after the use of the drops or the spray (fig. 2) was probably due to the fact that in both cases the head was hyperextended for a period of thirty to forty seconds, and simple mechanical obstruction to venous return from the head caused engorgement of the nasal tissues, just as the cutaneous vessels of the face become engorged, with resultant flushing. The head was not hyperextended for inhaler medication, and no initial nasal congestion occurred.

The chronic effects of vasoconstrictor drugs likewise support the choice of inhalers or sprays rather than nasal drops as the better means of nasal medication. The changes produced in the nasal mucosa by prolonged use of nasal drops are indicative of the possible effects of the use of drops by a patient with some chronic rhinologic condition requiring prolonged medication.

The comparative effectiveness of desoxyephedrine and amphetamine in the form of volatile inhalers has been established,[16] and one may theorize with comparative safety that the two drugs possess equal potency in the form of sprays or drops. This hypothesis is borne out by the similarity of the effects of prolonged use of the two drugs under identical conditions. The mucosal changes produced by d,l-desoxyephedrine are similar to those produced by d,l-amphetamine. The desoxyephedrine inhaler produced slightly less change than did the amphetamine.

The problem of blank control study has been solved by the application of the drug to only one nasal chamber, the opposite side serving as an ideal blank control for environmental conditions, extraneous infections and possible variations in histologic technic. Unilateral infection of the upper respiratory tract is seldom seen in rabbits, and studies of nasal mucosa from normal rabbits show much similarity between specimens of nasal mucosa from the two nasal chambers.

Controls made with isotonic solution of sodum chloride in the absence of the vasoconstrictor drugs were considered unnecessary as the same drugs were used in equal dosage by all methods, and the effects of chronic vasoconstriction become a part of the evaluation of the methods used.

The causes for the severe pathologic changes produced by nasal drops as compared with inhalers or sprays are not entirely clear. It seems unusual that the method which is shown to be least effective in producing clinical vasoconstriction should be the method most effective in producing damage to the nasal mucosa.

Burnham [19] described the effects of ephedrine and epinephrine on the nasal mucosa. He described mottled areas of red and regions of blanched mucosa after the application of 5 per cent ephedrine with a cotton-tipped applicator. It is possible that this may serve as a clue to the deleterious effects from the use of nasal drops; the vasoconstrictor reaches only certain localized regions of the nasal mucosa and is present in great concentration at these places, while other regions are untouched by the drug. Thus total nasal obstruction is not altered greatly, but local areas of the mucosa undergo profound and prolonged vasoconstriction. The vasoconstrictor solution reaches the more inferior portions of the nasal chamber and does not penetrate into the upper turbinated recesses, and repeated administration causes vasoconstriction of the same portions of the nasal mucosa. The effects of profound and prolonged vasoconstriction result in ischemia of the mucosa and submucosal tissue, and infection and metaplastic changes occur.

When the nasal inhaler or the spray is used, the drug reaches the nasal mucosa in a more diffuse form and is distributed to greater areas of the mucosa. This is

evident from the greater effectiveness of the inhaler or the spray in reducing nasal obstruction. The concentration of drug at any one point on the nasal mucosa is less than with drops, and the local vasoconstriction is less profound. Thus the mucosa is never severely ischemic at any one point, but the effect is spread throughout the nasal cavity, and no serious pathologic change results.

CONCLUSIONS

Comparative studies of the efficacy of methods of application of vasoconstrictor drugs to the nasal mucosa indicate that volatile inhalers and nasal sprays are similar in intensity and duration of effects produced, while nasal drops are far less effective as a method of medication.

The effects on the nasal mucosa produced by repeated administration of inhalers and sprays are similar, and both produced far less pathologic change than that resulting from the use of nasal drops.

It would seem that the selection of methods of medication in acute rhinologic conditions should be limited to nasal inhalers and sprays in most instances. When medication is desired in local areas of the nasal chamber, as at the ostium of a paranasal sinus, drops may be the method of choice.

In conditions requiring prolonged and repeated medication nasal drops should be used with caution, and sprays or inhalers are suggested as the methods of choice.

303 East Chicago Avenue.

PROPER AND IMPROPER ADMINISTRATION OF OILY NASAL SPRAYS

BRUNO L. GRIESMAN, M.D.
NEW YORK

Is the intranasal administration of a medicated oil within the limits of normal therapeutic dosage necessarily a dangerous clinical procedure?

Since the first description, by Laughlen,[1] in 1925, of lipoid pneumonia following the aspiration of nasal oil drops cautious physicians have been asking themselves this question, with few precise scientific data available from which to draw a reliable conclusion.

Doubtless the widespread abuse of intranasal oils by the public, with the inevitable tendency toward overdosage and too prolonged treatment, has contributed largely to the cloud of suspicion that has developed. An editorial in *The Journal of the American Medical Association*[2] called attention to this consideration with the observation, "There is unanimity of opinion among investigators as to the dangers of intranasal medication with oils, particularly as is seen in the uncontrolled use by the public of the various preparations of liquid petrolatum."

While such self medication cannot be condemned too emphatically, it still does not impose any conclusive judgment on the propriety of this technic in the hands of the doctor—whose primary concern remains to determine under what circumstances and by what technic of administration medicated oils may be employed with full safety and with maximum advantage to the patient.

Since Laughlen first called attention to the possible pulmonary threat implicit in the intranasal employment of medicated oils, some 250 cases of lipoid pneumonia have been reported in the international medical literature over a period of nearly twenty years. Even of this relatively small number of cases (in view of the tremendous quantities of oils thus employed) it is to be noted that only about 25 per cent have been attributed to the intranasal instillation of liquid petrolatum—the remaining 75 per cent having their etiologic explanation in the oral ingestion of laxative oils, vitamin oils and other oils and fats, including milk and egg yolk.

The belief has been advanced that infants, debilitated children and aged persons are more likely to aspirate oils instilled into the nose or taken into the mouth and that use of liquid petrolatum is generally contraindicated for such persons and for persons with lesions of the tongue or the pharynx or patients with hemiplegia or neurogenic disturbances.

For instance, Cannon and Walsh[3] suggested that

> . . . Because of the smoothness of the oil, however, and perhaps because of a mild anesthetic action of menthol, the oil tends to gravitate from the nasopharynx to the trachea without eliciting a cough reflex or stimulating the reflex closure of the epiglottis. The passage of

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From the Service of Dr. John D. Kernan, Department of Otolaryngology, Presbyterian Hospital, and the College of Physicians and Surgeons, Columbia University.

1. Laughlen, G. F.: Studies on Pneumonia Following Nasopharyngeal Injections of Oil, Am. J. Path. **1**:407-414 (July) 1925.

2. Lipoid Pneumonia, editorial, J. A. M. A. **114**:251 (Jan. 20) 1940.

3. Cannon, P. R., and Walsh, T. E.: Lipoid Pneumonia and Some Potential Dangers of Intranasal Medication, Internat. Clin. **3**:109-115 (Sept.) 1938.

oil from the nose to the trachea and lungs is particularly liable to take place in infants lying on their backs, and it is probably in this way that much of the lipoid aspiration occurs.

Elaborating this point, however, Cannon [4] in his excellent review "The Problem of Lipid Pneumonia" emphasized the ease with which light oils and fluids can pass from the upper respiratory passages to the lungs:

> The earlier reports on the occurrence of lipid pneumonia led to the belief that it is essentially a disease of infants and children. Accumulated evidence has proved, however, that it affects all ages, and at least 105 cases, most of which were discovered at necropsy, have been reported in adults. The view, furthermore, that it occurs almost entirely in weakened individuals and particularly in those with defects of deglutition is no longer correct; it is now certain that healthy persons may develop severe types of lipid pneumonia, especially if they use medicated liquid petrolatum intranasally in large quantities over long periods of time.

In speculating on the mode of entrance into the lungs, Cannon placed the responsibility on the degree of overdosage, the frequency of application and the extent to which the epiglottis functions effectively.

Are these the principal factors contributing to the possibility of tracheal leakage? To find a decisive answer to this question, the present study was undertaken.

In this investigation, no study of the therapeutic value of oils in the nose was felt to be necessary. Rather, by controlled administration and roentgenographic examination, the distribution of intranasally sprayed oils—both in therapeutic dosage and in massive overdosage—was traced from their entrance into the vestibule of the nose, to determine to what degree they might traverse the nasopharynx, the mesopharynx and the hypopharynx into the esophagus or into the larynx, trachea and lungs.

In order to compare several different oils as to their action, sesame oil, liquid petrolatum and a medicated liquid petrolatum were individually admixed with iodized poppyseed oil (for roentgenographic visibility) in the following proportions:

75 per cent sesame oil with 25 per cent iodized oil
75 per cent liquid petrolatum with 25 per cent iodized oil
75 per cent medicated liquid petrolatum with 25 per cent iodized oil
50 per cent sesame oil with 50 per cent iodized oil
50 per cent liquid petrolatum with 50 per cent iodized oil
50 per cent medicated liquid petrolatum with 50 per cent iodized oil

Thirty-one patients were selected for testing, only those with no history or evidence of infection of the upper respiratory tract being included. Their ages ranged from 6½ to 66 years.

The procedure involved the intranasal administration of a known amount of iodized oil, in most cases by hand atomizer spray (in 2 cases by dropper). At stated intervals following the administration of oil roentgenograms were made in order that the distribution and the gravitation of the oil might be visualized.

This followed a routine procedure—developed after some preliminary testing—in which the patient was seated in a chair and a "flat" roentgenogram first made with the head in the desired position before the oil was administered, since calcifications of the laryngeal cartilages might interefere with the shadows cast by the oil mixtures and thus confuse the interpretation of the subsequent roentgenograms. In some cases a 1 per cent solution of an ephedrine salt was first sprayed into the nostrils to shrink the tissues and permit freer distribution of the oil.

4. Cannon, P. R.: The Problem of Lipid Pneumonia, J. A. M. A. **115**:2176-2179 (Dec. 21) 1940.

After the oil was sprayed into the nose, exposures were made at certain intervals —from a few seconds to several minutes after instillation—with the tube, the head and the plate in exactly the same position. In this way errors in interpretation were avoided.

Since the primary object of this study was to determine what happened under normal therapeutic dosage—with a secondary object of establishing the factor of safety afforded by different technics of administration—the criterion of normal dosage was first set up as one-half dropperful of oil in each nostril, the dosage recommended by a leading ethical manufacturer. One-half dropperful actually conveys 15 drops, so that the maximum amount which should be administered in both nostrils in normal therapeutic dosage totals 30 drops.

For administration by atomizer it was determined by careful tests that two squeezes of the hand nebulizer delivered approximately the same amount of oil as one-half dropperful (each squeeze being a firm squeeze on the atomizer bulb to attain the maximum spray volume). A total of four squirts from the nebulizer was therefore established as the normal therapeutic dose.

In conducting these tests both a normal dose and excessive doses were administered, as follows:

8 patients received 2 squirts in each nostril (normal dose)
2 patients received 3 squirts in each nostril (excessive dose)
7 patients received 4 squirts in each nostril (excessive dose)
8 patients received 5 squirts in each nostril (excessive dose)
3 patients received 8 squirts in each nostril (excessive dose)
1 patient received 10 squirts in each nostril (excessive dose)
1 patient received 5 drops in each nostril (normal dose)
1 patient received 10 drops in each nostril (normal dose)

In appraising the results in each case the following factors were taken into consideration:

1. The condition of the intranasal airways.
2. The presence or the absence of tonsils and adenoids.
3. The presence or the absence of scar formation in the tonsillar beds, and injury (or not) of the anterior or the posterior pillars.
4. The motility of the soft palate during phonation.
5. The position of the head.
   (*a*) Head tilted far back or moderately backward
   (*b*) Head held straight.
   (*c*) Head inclined forward.
6. Whether or not a 1 per cent solution of an ephedrine salt was sprayed into both nostrils prior to administration of the oil spray.
7. The number of squeezes on the nebulizer employed for each nostril or the number of drops administered.

The accompanying table 1 summarizes the observations with reference to the distribution of the oil in relation to the amount of medication, the position of the head, the patient's age, the prior use of ephedrine, the presence or the absence of tonsils and adenoids, the combination of oils employed and the roentgen diagnosis.

Especially interesting results were established by using different methods of applying oil in the same patient in several instances—with careful observation of the different results achieved through the variations in technic. Five patients received treatment by such alternate technic on different days. The findings observed in the individual cases are given in table 2.

TABLE 1.—*Details of the Experiments*

Subject	Age	Squirts in Each Nostril	Oil Administered	Position of Head	Administration of Ephedrine	Adenoids, Tonsils	Roentgen Observations of Distribution of Oil
1	24	2	Medicated liquid petrolatum plus iodized oil (equal parts)*	Far back	Yes	Out	In vallecula, piriform sinus, esophagus
2	31	2	Medicated liquid petrolatum plus iodized oil (equal parts)	Far back	No	Out	Surface of epiglottis
3	44	2	Medicated liquid petrolatum plus iodized oil (equal parts)	Backward	No	In narrow airways	No leakage
4	33	2	Medicated liquid petrolatum (75%) plus iodized oil (25%)	Straight	Yes	Out	No leakage
5	6½	2	Liquid petrolatum plus iodized oil (equal parts)	Forward	No	Out	No leakage
6	66	2	Medicated liquid petrolatum plus iodized oil (equal parts)	Straight	No	Out	No leakage
7	66	10 drops	Medicated liquid petrolatum plus iodized oil (equal parts)	Backward	No	Out	In aditus laryngis
8	22	2	Medicated liquid petrolatum plus iodized oil (equal parts)	Far back	No	Hypertrophic	In hypopharynx, mesopharynx, nasopharynx
9	22	2	Medicated liquid petrolatum plus iodized oil (equal parts)	Far back	No	Hypertrophic	In trachea
10	11½	3	Medicated liquid petrolatum plus iodized oil (equal parts)	Backward	No	Out	In piriform sinus, esophagus
11	18	3	Medicated liquid petrolatum (75%) plus iodized oil (25%)	Backward	No	Out	In vallecula, aryepiglottic fold
12	10	4	Medicated liquid petrolatum plus iodized oil (equal parts)	Forward	Yes	Out	No leakage
13	33	4	Sesame oil plus iodized oil (equal parts)	Forward	Yes	In	No leakage
14	24	4	Medicated liquid petrolatum plus iodized oil (equal parts)	Forward	Yes	In	No leakage
15	43	4	Medicated liquid petrolatum plus iodized oil (equal parts)	Backward	No	In	"s" pronunciation used
16	49	4	Medicated liquid petrolatum plus iodized oil (equal parts)	Backward	Yes	In	"o" phonation used
17	50	4	Medicated liquid petrolatum (75%) plus iodized oil (25%)	Backward	No	Out	In vallecula and piriform sinus
18	57	4	Medicated liquid petrolatum plus iodized oil (equal parts)	Backward	No	Out	In nasopharynx and hypopharynx
19	29	5	Medicated liquid petrolatum plus iodized oil (equal parts)	Straight	Yes	In	No leakage
20	24	5	Medicated liquid petrolatum plus iodized oil (equal parts)	Slightly up	No	Out	No leakage
21	37	5	Sesame oil plus iodized oil (equal parts)	Forward	No	Out	No leakage
22	12	5	Medicated liquid petrolatum plus iodized oil (equal parts)	Forward	Yes	Out	No leakage
23	27	5	Sesame oil plus iodized oil (equal parts)	Forward	Yes	Out	No leakage
24	12	5 drops	Medicated liquid petrolatum plus iodized oil (equal parts)	Far back	No	Out	In mesopharynx and hypopharynx
25	26	5	Liquid petrolatum plus iodized oil (equal parts)	Far back	No	Out	In right lower lung
26	26	5	Medicated liquid petrolatum plus iodized oil (equal parts)	Backward	No	Out	"s" pronunciation used
27	27	5	Medicated liquid petrolatum plus iodized oil (equal parts)	Backward	Yes	Out	In larynx
28	33	8	Medicated liquid petrolatum plus iodized oil (equal parts)	Forward	No	Out	No leakage
29	31	8	Medicated liquid petrolatum plus iodized oil (equal parts)	Forward	No	Out	No leakage
30	29	8	Sesame oil plus iodized oil (equal parts)	Forward	Yes	Out	No leakage
31	49	10	Medicated liquid petrolatum plus iodized oil (equal parts)	Straight	Yes	In	No leakage

* The iodized oil used was iodized poppyseed oil 40 per cent.

REPORT ON NINE PATIENTS RECEIVING TWO SQUIRTS OF OIL IN EACH NOSTRIL (NORMAL RECOMMENDED DOSAGE)

With Head Tilted Backward.

CASE 1.—A woman aged 24 had a perforation about in the middle of the nasal septum with some crusting bilaterally. Both nasal airways were open. The tonsils were out; the posterior pillars were well preserved; the anterior pillars were not present. Some scarring was seen in both tonsillar beds. The velum moved perfectly. Before a roentgenogram was made a 1 per cent solution of an ephedrine salt was sprayed into both nostrils, and the crusts in both nares were removed by nasal irrigation. The patient stated that for removal of the crusts she had used oily nasal drops once or twice daily for about one year. Two squirts of a mixture of the medicated liquid petrolatum (50 per cent) and the iodized oil (50 per cent) were administered with the head tilted back.

Fifteen seconds after the spraying with oil the backward inclination of the head and the shrinking effect of the 1 per cent ephedrine salt solution allowed the oil to travel down along the posterior pharyngeal wall, the soft palate and the uvula to the base of the tongue. The vallecula epiglottica, the laryngeal surface of the epiglottis and the entrance of the esophagus were clearly covered with oil, and some oil appeared in the esophagus. Forty-five seconds after the spraying the oil clung to the laryngeal surface of the epiglottis and slid down along the aryepiglottic folds to the piriform sinuses. A path of oil was visible in the esophagus. No oil was seen in the larynx itself or in the trachea. Five and a half minutes after the spraying a roentgenogram of the chest failed to demonstrate any evidence of oil in the lungs.

TABLE 2.—*Five Patients Receiving Oil with Alternate Technic*

	Same Subject	Squirts or Drops in Each Nostril	Position of Head	Roentgen Observation of Distribution of Oil
1	Case 6	2 squirts	Straight	In the nasal cavity
	Case 7	10 drops	Far backward	In the aditus laryngis
2	Case 8	2 squirts	Backward	In the hypopharynx
	Case 9	2 squirts	Far backward	In the trachea
3	Case 23	5 squirts	Forward	In the nasal cavity
	Case 24	5 drops	Far backward	At the epiglottis
4	Case 25	5 squirts	Far backward	In the right lower lung
	Case 26	5 squirts	Far backward with "s" pronunciation	Blocking of the rapid gravitation
5	Case 23	5 squirts	Forward 45 degrees	In the nasal cavity
	Case 27	5 squirts	Backward	In the trachea

CASE 2.—A woman aged 31 had a nasal septum deflected to the right without obstruction. Both airways were open. The nasopharynx contained no adenoid tissue. The tonsils were out; both pillars were preserved and there was not much scarring of the tonsillar beds. The velum moved normally during phonation. No ephedrine was used. The head was tilted far backward. Two sprayings with the medicated liquid petrolatum (50 per cent) plus iodized oil (50 per cent) were administered in each nostril.

Twenty seconds after the spraying the oil reached the uvula. One minute after, the oil traveled along the base of the tongue, covering the epiglottis. Most of the oil apparently condensed on the floor of the nose and traveled downward by force of gravity. Four minutes after the spraying a roentgenogram of the chest failed to demonstrate any evidence of oil in the lungs.

CASE 3.—A woman aged 44 had a nasal septum slightly deflected to the left. The turbinates were congested. Both airways were obstructed. The tonsils were small, atrophic. The velum moved perfectly during phonation. No ephedrine was used. Two squirts of the medicated liquid petrolatum (50 per cent) plus iodized oil (50 per cent) were administered with the head tilted moderately far back.

Fifty seconds after the spraying no oil was visible in the nasopharynx, the mesopharynx or the hypopharynx. This shows that there is no leakage of oil into the nasopharynx in a patient with obstructed nasal airways, even with the head tilted back.

With Head Inclined Forward.

CASE 5.—A child aged 6½ had no pathologic condition of the nose. The tonsils and adenoids had been removed. No ephedrine was used. Two squirts of a mixture of liquid petrolatum (50 per cent) and iodized oil (50 per cent) were applied in each nostril with the head inclined forward.

The oil was visualized only in the nasopharynx along the hard and soft palate. There was no leaking into the mesopharynx, the hypopharynx or the larynx even five minutes after the spraying when the head remained continuously tilted forward.

With Head Held Straight.

CASE 4.—A woman aged 33 had narrow nasal airways, a septum deflected to the right and an enlarged left inferior turbinate. The tonsils were out, the right posterior pillar was half removed and the velum showed poor motility during phonation. The nasopharynx contained some adenoid tissue. Shortly before the spraying of oil, a spray of a 1 per cent solution of an ephedrine salt was applied three times in both nostrils. Two squirts of a mixture of the medicated liquid petrolatum (75 per cent) and the iodized oil (25 per cent) were administered in each nostril with the head held straight.

The oil remained in the vestibule and on the floor of the nose. Fifteen seconds after the spraying no oil was visible in the nasopharynx in spite of the administration of a 1 per cent solution of an ephedrine salt prior to the spraying.

CASE 6.—A man aged 66 had a nasal septum deflected to the right. The posterior ends of both inferior turbinates were hypertrophied. Both airways were open but rather narrow. The tonsils were out, the left posterior pillar had been removed and there was some scarring in the left tonsillar bed. No ephedrine was used prior to spraying with oil. Two squirts of the medicated liquid petrolatum (50 per cent) plus iodized oil (50 per cent) were applied in each nostril, with the head held in an absolutely straight position. Roentgenograms were taken twenty seconds, one minute and three minutes after the instillation of oil.

No vestige of oil was discernible in the nasopharynx, the mesopharynx or the hypopharynx or in the larynx.

With Head Tilted Backward.

CASE 7 (same patient as in case 6).—Fifteen minutes after the experiment just described, the head of the same person was tilted far backward. Ten drops of a mixture of the medicated liquid petrolatum (50 per cent) and the iodized oil (50 per cent) was placed in each nostril with a glass dropper. Ten seconds later a roentgenogram showed a path of oil extending from the soft palate to the posterior pharyngeal wall and down the hypopharynx to the level of the thyroid cartilage. After thirty-five seconds the trace of oil could be followed to the aditus laryngis.

Two and a half minutes later only a faint streak of oil was visible.

Examination of the roentgenograms made after two sprayings in each nostril with the head held straight fails to demonstrate any evidence of leaking into the nasopharynx or into the lower respiratory tract. However, only 10 drops of oil instilled in each nostril of the same person with the head tilted far backward penetrates dangeruosly near the aditus laryngis.

CASE 8.—A woman aged 22 had a nasal septum deflected to the left. Both airways were open. Adenoid tissue was present in the nasopharynx. The tonsils were hypertrophied so that they touched each other nearly in the midline. The velum showed normal motility during phonation. No ephedrine was used prior to the oil spray. The head was tilted backward. Two squirts of the mixture containing the medicated oil (50 per cent) and the iodized oil (50 per cent) were applied in each nostril.

The roentgenograms taken after twenty seconds reveal that there was leaking of the oil mixture into the nasopharynx, and those taken after forty seconds that there was leaking into the mesopharynx and the hypopharynx.

Hypertrophied tonsils and adenoids seem to offer no protection to the downward sliding of intranasally sprayed oils when the head is tilted far backward.

CASE 9 (same patient as in case 8 with the head thrown still farther back).—No ephedrine was used, and the same amount of the same mixture was employed.

Fifteen seconds after the spraying the oil was visible in the mesopharynx and near the epiglottis, in the vallecullae. Thirty-five seconds after the spraying the oil slid down, traveling from the mesopharynx along the posterior pharyngeal wall. The upper orifice of the esophagus appeared closed, and the oil crossed over from behind the arytenoid cartilages, dropping into the larynx between the vocal cords (fig. 1 *A*). Three minutes after the spraying a definite shadow representing the oil at the anterior wall of the trachea became visible (fig. 1 *B*).

In spite of the hypertrophied tonsils and adenoids, there is a clear tracheal leakage with the head thrown very far back.

Summary of Findings with Administration of Two Squirts of Oil (Normal Therapeutic Dosage).

Roentgenographic examination following the application of oily nasal sprays in the recommended therapeutic dosage (two squirts in each nostril) in 8 cases reveals that at least a potential danger of aspirating oil may exist when the oil is applied with the head thrown far back. The shrinking effect of a 1 per cent solution of an ephedrine salt prior to the administration of oil appears to have no influence on the situation. The danger of aspirating oil is not present when the head is held straight or tilted forward during and after the spraying of oil.

Thus the danger of aspirating oil is nonexistent when the oil has no opportunity to travel by gravity. With the head tilted backward the anterior nasal spine is the highest point from which the oil can gravitate. With the head held straight or bent forward the force of gravity is not operative.

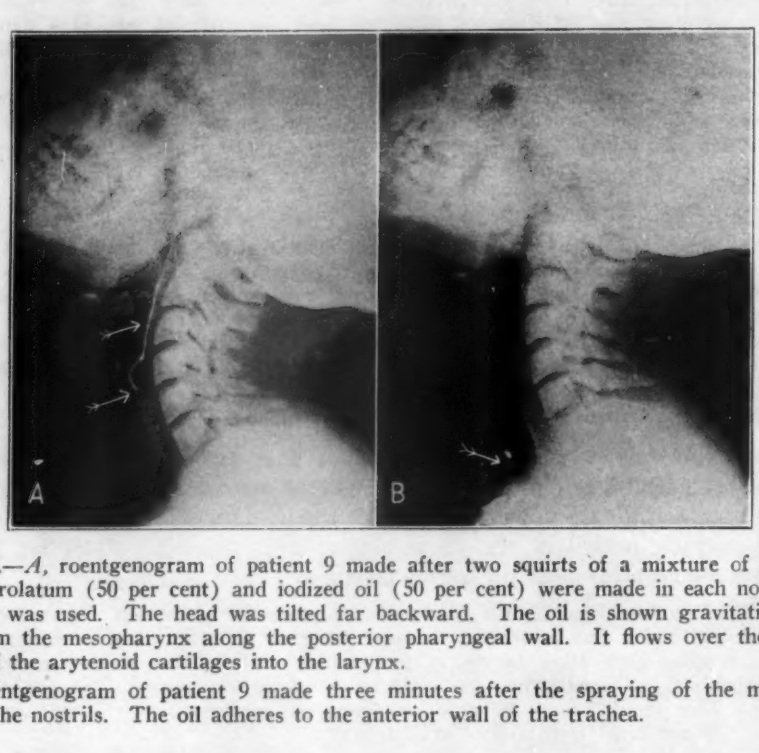

Fig. 1.—*A*, roentgenogram of patient 9 made after two squirts of a mixture of medicated liquid petrolatum (50 per cent) and iodized oil (50 per cent) were made in each nostril. No ephedrine was used. The head was tilted far backward. The oil is shown gravitating downward from the mesopharynx along the posterior pharyngeal wall. It flows over the anterior surface of the arytenoid cartilages into the larynx.

B, roentgenogram of patient 9 made three minutes after the spraying of the mixture of oils into the nostrils. The oil adheres to the anterior wall of the trachea.

REPORT ON TWO CASES WITH THREE SQUIRTS IN EACH NOSTRIL WITH HEAD HELD MODERATELY BACKWARD

Case 10.—The subject was a boy 11½ years of age, with the tonsils and adenoids out. There was no previous administration of ephedrine. Three squirts of the medicated oil (50 per cent) plus iodized oil (50 per cent) were applied in each nostril with the head held moderately backward. Roentgenograms were taken one and one-half minutes, three and one-half minutes and six minutes after the spraying.

Case 11.—The patient was a woman 18 years of age. She had undergone submucous resection five years ago. The tonsils were out. Some adenoid tissue was present in the nasopharynx. No ephedrine was used. With the head tilted moderately backward, a mixture of the medicated oil (75 per cent) and the iodized oil (25 per cent) was applied. Roentgenograms were made one minute, three minutes and five minutes afterward.

In these 2 patients—with the head tilted moderately backward—roentgen examination disclosed that oil had penetrated to the vallecula and the piriform sinuses.

REPORT ON SEVEN CASES WITH FOUR SQUIRTS IN EACH NOSTRIL

Of the 7 patients who received four squirts in each nostril, 3 (12, 13 and 14) had the head inclined forward, and 4 (15, 16, 17 and 18) had the head tilted backward.

With Head Inclined Forward.

The details of cases 12, 13 and 14 are given in table 1. In spite of the use of a plentiful amount of a 1 per cent solution of an ephedrine salt previous to the spraying with oil, the roentgenograms showed no evidence of any tracheal leakage or even of any penetration into the nasopharynx and to the posterior pharyngeal wall when the head was held in a forward inclined position during and after the application of the oil.

With Head Held Moderately Backward.

CASE 15.—The head was tilted moderately backward, and the nasopharynx was sealed off by pronunciation of the consonant "s." The roentgenograms disclosed that the main part of the oil mixture lay at the anterior part of the soft palate. One could safely presume that the oil would slide downward into the mesopharynx as soon as the velum relaxed and the patient stopped pronouncing "s."

CASES 16 to 18.—In contrast to case 15, cases 16, 17 and 18 demonstrate convincingly the significance of the position of the head for gravitation of oil. In all these cases the path of oil pointed to the mesopharynx and hypopharynx.

REPORT ON EIGHT CASES WITH FIVE SQUIRTS IN EACH NOSTRIL

With Head in a Straight Position.

CASE 19.—The patient was a woman aged 29. The nasal septum was straight and both airways were open. The tonsils were in place and small. The velum moved perfectly during phonation. A 1 per cent solution of an ephedrine salt was sprayed abundantly prior to the administration of oil in order to shrink the mucous membrane as much as possible. Five squirts of the mixture of the medicated oil (50 per cent) and the iodized oil (50 per cent) were applied in each nostril.

Roentgenograms made ten seconds, forty-five seconds, two and three-quarter minutes and four minutes after the spraying failed to demonstrate any evidence of leaking of oil into the nasopharynx, the mesopharynx, the hypopharynx or the larynx.

With Head Tilted Forward.

CASE 20.—The subject was a man aged 24. The nose showed no pathologic condition. The tonsils were out. The head was bent slightly forward. There was no previous use of an ephedrine spray. Five squirts of a mixture of the medicated oil (50 per cent) and the iodized oil (50 per cent) were administered in each nostril. Roentgenograms were taken after one minute, two and one-half minutes and four minutes.

CASE 21.—The patient was a woman aged 37. The tonsils had been removed. No ephedrine spray was used. The head was tilted forward so that the chin and the external auditory meatus, in the same plane, formed an angle of 45 degrees with the horizontal plane, and five squirts of a mixture of sesame oil (50 per cent) and iodized oil (50 per cent) were applied in each nostril. Roentgenograms were taken one and two minutes after the spraying. Exactly two minutes after the spraying the head was thrown backward and held in this position. Roentgenograms were taken four minutes and five and one-half minutes after the initial spraying.

CASE 22.—The patient was a girl aged 12. The tonsils and adenoids had been removed. There was no scarring in the tonsillar beds. An ephedrine saline spray was used in both nostrils prior to spraying with oil. With the head tilted forward as in case 21, five squirts of a mixture of the medicated liquid petrolatum (50 per cent) and the iodized oil (50 per cent) were applied in each nostril. Roentgenograms were made one-fourth, one-half, 2 and one-fourth and four minutes after the spraying with oil.

CASE 23.—A man aged 27 had a nasal septum deflected to the left, obstructing the left middle meatus. The right airway was far open. The nasopharynx showed no adenoid tissue and was very spacious. The oropharynx had been cleared of the tonsils except for some tabs in the right tonsillar bed. There was much scarring on the left anterior and posterior pillars. An ephedrine saline spray was instilled in each nostril prior to spraying with oil. The head was tilted forward so that the chin and the external auditory meatus, in the same plane, formed an angle of 45 degrees with the horizontal plane. Roentgenograms were made one, two, four and six minutes after the use of the oil spray.

In all 5 cases, with the head held straight or bent forward, and with 5 squirts in each nostril, there was no aspiration of oil into the nasopharynx, the mesopharynx, the hypopharynx or the larynx. Even previous shrinkage of the nasal mucous membranes with a 1 per cent solution of an ephedrine salt failed to allow any leaking of oil into the lower respiratory passages. In case 21, with the head thrown backward two minutes after the administration of oil, the subsequent roentgenograms (taken four and five and one-half minutes afterward) failed to demonstrate any leaking of oil into the lower respiratory cavities.

With Head Tilted Far Backward.

CASE 24 (same patient as in case 22).—This 12 year old girl whose roentgenograms with the head tilted forward did not disclose any vestige of oil in the nasopharynx or the oropharynx in spite of the use of a great amount of a 1 per cent solution of an ephedrine salt previous to the five squirts of the oil mixture received another examination on a different day. This time her head was tilted far backward. No ephedrine was used, and only five drops of a mixture of the medicated liquid petrolatum (50 per cent) and the iodized oil (50 per cent) were instilled in each nostril. Fifteen seconds later the oil had reached the uvula, and one-half minute later the oil covered the laryngeal surface of the epiglottis.

CASE 25.—The subject was a woman aged 26. Both nasal airways were fairly open. The tonsils had been removed. There was much scar formation in both tonsillar beds. The nasopharynx showed no adenoid tissue. Motility of the velum was normal. However, the soft palate appeared distracted because of the scar formation in both tonsillar beds. No ephedrine was used previous to the spraying of oil. The head was held far backward, while five squirts of a mixture of liquid petrolatum (50 per cent) and iodized oil (50 per cent) were applied in each nostril.

The roentgenogram (fig. 2 *B;* fig. 2 *A* shows the "flat" roentgenogram) taken immediately after the spraying revealed the oil dripping from the tip of the uvula and traveling from the nasopharynx along the posterior pharyngeal wall to the piriform sinuses. The oil overflowed the arytenoid cartilages into the larynx. At the end of ten squirts one found the oil in the interior of the larynx and on the vocal cords, whence it gravitated into the trachea.

The factor explaining this amazing rapid flow of the oil seems to be the position of the head. The anterior nasal spine represents the highest point whence the downward movement of the oil starts, and apparently nothing more or less than the force of gravity governs the flow of the oil.

The roentgenogram taken one-half minute after the administration of the oil shows it scattered all over the nasopharynx and the hypopharynx because the patient coughed and spat out some oil by bending her head forward (fig. 2 *C*). Three and one-half minutes after finishing the spraying, one could still observe the oil dripping from the uvula and adhering to the mucous membrane of the upper respiratory passages and to the anterior wall of the trachea. A roentgenogram of the chest six minutes later showed the oil in the descending branches of the right bronchus (fig. 2 *D*).

Thus it is obvious that the tilting of the head far backward with five squirts of oil in each nostril facilitates gravitation of the oil into the bronchial tree.

CASE 26 (same patient as in case 25).—On a subsequent day this patient was examined with her head in the same position and with the same amount and type of oil mixture. The only difference was that she was asked to pronounce the consonant s during and after the spraying of oil. During the production of the sound s the soft palate is raised against the posterior wall of the pharynx and seals the nasopharynx tightly.

A number of roentgenograms were taken at intervals of one-half, three-quarters, two and one-half and three and one-half minutes after the spraying with oil. Figure 3 *A* to *E* shows these roentgenograms. *A*, the "flat" roentgenogram, shows the position of the head and the relaxed soft palate. *B* shows the sealing of the nasopharynx during the pronunciation of s. *C* was taken one-half minute after five squirts of a mixture of the medicated liquid petrolatum (50 per cent) and the iodized oil (50 per cent) were sprayed in each nostril. The oil can be seen lying on the level of the nasal floor. Compared with case 25, in which immediately after the spraying the piriform sinuses were filled with oil, case 26 shows that sealing of the nasopharynx through pronunciation of s seems to be an efficient factor for avoiding tracheal leakage. *D*, taken three-quarters of a minute after the spraying, clearly demonstrates this sealing. *E*, taken two and one-half minutes later, shows the oil on the posterior pharyngeal wall, gravitating along the base of the tongue to the valleculae. The oil was still visible in the valleculae after three and one-half minutes.

When this case is compared with case 25, in which the same amount of oil and the same position of the head were used (the only difference being in the pronunciation of s), there can be no doubt that pronouncing s during and after spraying caused effective blocking of the rapid gravitation of oil into the lower respiratory passages.

CASE 27 (same patient as in case 23).—A 1 per cent ephedrine saline solution was sprayed into each nostril fifteen minutes before five squirts of a mixture of the medicated liquid petrolatum (50 per cent) and the iodized oil (50 per cent) were likewise administered with the head tilted backward and kept in this position. Roentgenograms were made three-quarters, one, three and one-quarter and four minutes afterward. Forty-five seconds after the administra-

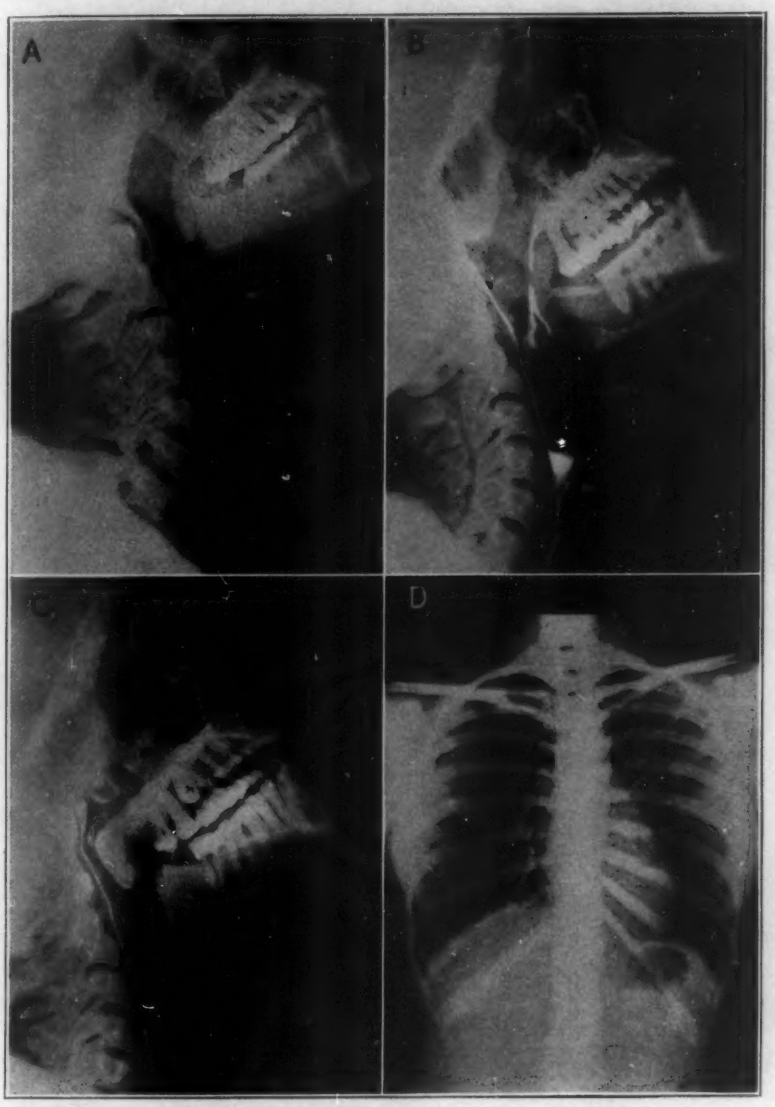

Fig. 2 (case 25).—*A*, "flat" roentgenogram.

B, roentgenogram made after five squirts of a mixture of liquid petrolatum (50 per cent) and iodized oil (50 per cent) had been applied in each nostril. There was no previous administration of ephedrine. The head was tilted far backward. Immediately after the spraying the oil drops from the uvula and travels from the nasopharynx along the posterior pharyngeal wall downward to the piriform sinuses. From here it flows into the larynx and slides down the posterior tracheal wall. A patch of oil is visible on the vocal cords.

C, roentgenogram made one-half minute after the spraying. The oil is scattered all over the nasopharynx and the hypopharynx as a result of coughing.

D, roentgenogram of the chest made six minutes after the spraying. The oil is in the descending branches of the right bronchus.

tion of oil (fig. 4 *A*) the path of the oil was clearly visible: soft palate, tip of uvula, base of tongue, valleculae and piriform sinuses, descending into the larynx and the trachea. One minute afterward the oil appeared above and below the vocal cords, in the ventricle, and was sliding down on the anterior wall of the trachea (fig. 4 *B*). The roentgenograms made after three and one-half and four minutes demonstrated the oil adhering to the mucous membrane of the upper airways and the trachea. It should be emphasized that there was no sign of any coughing reflex during the entire examination.

This case clearly proves the decisive influence of the position of the head on the distribution of intranasally sprayed oils. The patient had considerable scarring in both tonsillar beds. An ephedrine saline solution was first applied to both nostrils. Then, with the head

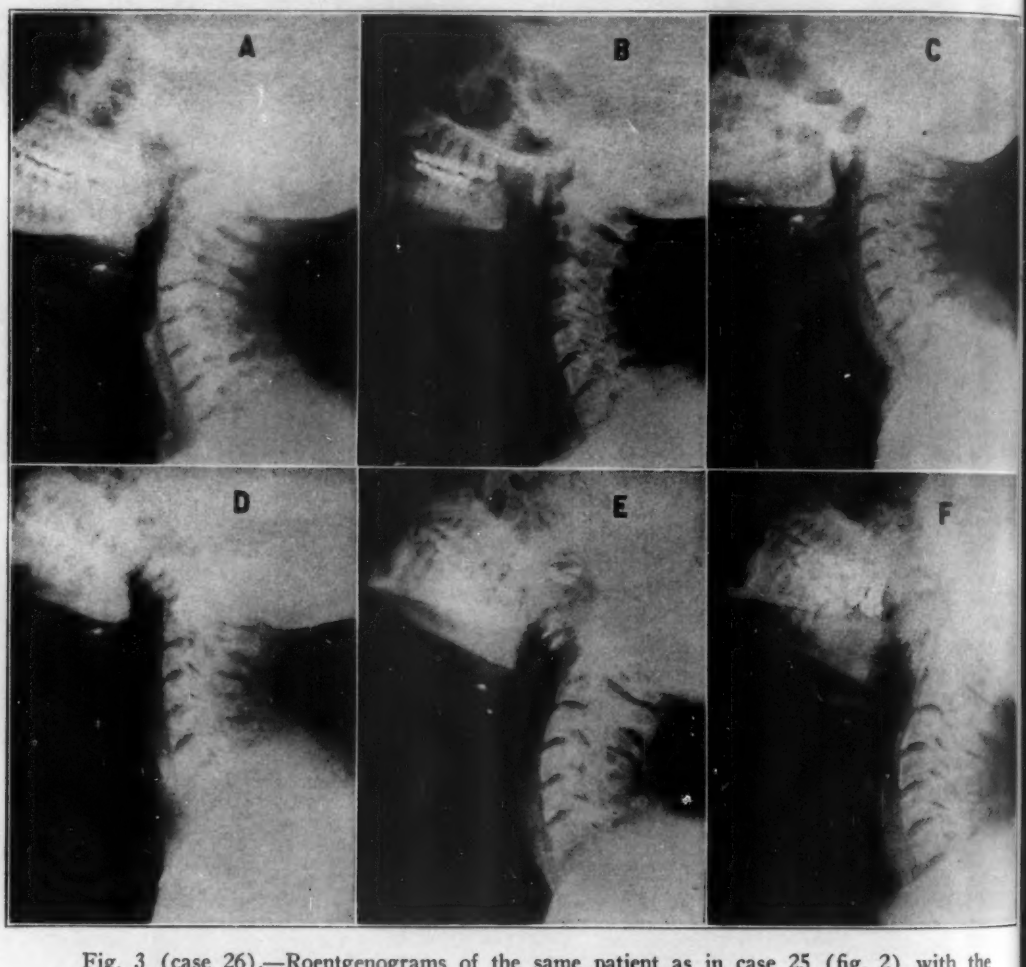

Fig. 3 (case 26).—Roentgenograms of the same patient as in case 25 (fig. 2) with the head tilted far backward. No ephedrine was used.

A, flat roentgenogram with the soft palate relaxed.

B, roentgenogram of the patient pronouncing the consonant s. Note that the soft palate seals the nasopharynx.

C, roentgenogram made one-half minute after five squirts of a mixture of medicated liquid petrolatum (50 per cent) and iodized oil (50 per cent) were sprayed in each nostril under constant pronouncing of s. The oil is lying on the level of the nasal floor.

D, roentgenogram made three-quarters minute after the spraying with oil.

E, roentgenogram made two and one-half minutes after the spraying. The oil gravitates downward.

F, roentgenogram made three and one-half minutes after the spraying. The oil is in the vallecula.

tilted backward, five squirts of oil were instilled into each nostril. Forty-five seconds later the roentgenogram revealed a definite tracheal leakage. The same patient (case 23) with administration of the same ephedrine saline solution and the same amount of oil but with a different position of the head (bent forward) failed to demonstrate any tracheal leakage or even any vestige of oil in the mesopharynx.

REPORT ON THREE CASES WITH EIGHT SQUIRTS

With Head Tilted Forward.

CASE 28.—A woman aged 33 had a nasal septum deflected to the right, an enlarged left inferior turbinate and airways fairly open. The tonsils were out, and the right posterior pillar was half removed. The velum moved poorly during phonation. No ephedrine was used. The head was tilted slightly forward so that the chin and the external auditory meatus, in the same plane, formed an angle of 45 degrees with the horizontal plane. With eight squirts the medicated liquid petrolatum (50 per cent) plus iodized oil (50 per cent) was sprayed in each nostril, which took nearly thirty seconds. These sixteen squirts equal about 2 cc. of oil. Roentgenograms were made immediately, one-half, three and five minutes after the spraying.

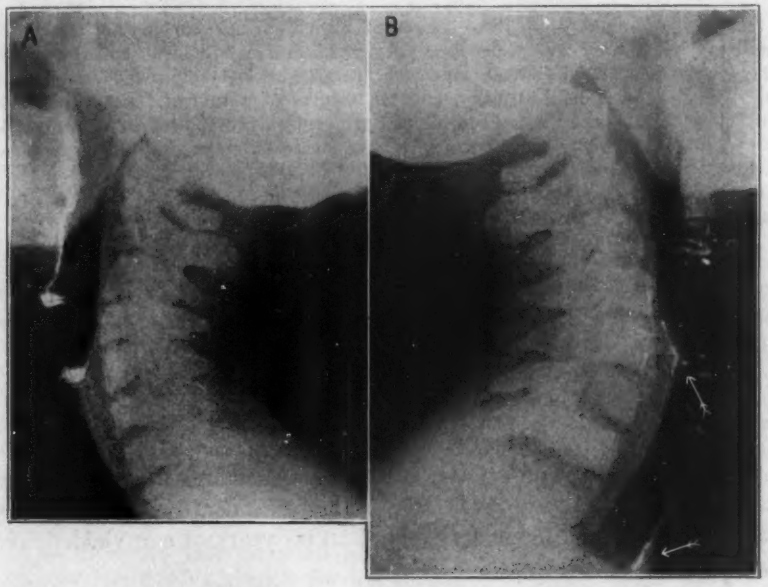

Fig. 4 (case 27).—*A*, roentgenogram made three-fourths minute after five squirts of a mixture of medicated liquid petrolatum (50 per cent) and iodized oil (50 per cent) had been made in each nostril. A 1 per cent solution of an ephedrine salt was sprayed into both nostrils prior to the administration of oil. The head was tilted far backward. The path of the oil, following the force of gravity, is clearly visible: soft palate, tip of the uvula, base of the tongue, vallecula, piriform sinus, larynx and trachea.

B, roentgenogram made one minute after the spraying with oil. The oil is above and below the vocal cords and along the anterior wall of the trachea. (See arrows.)

The first three roentgenograms showed most of the oil in the anterior part of the nose, particularly in the groove behind the anterior nasal spine. The uvula and the posterior part of the soft palate, the nasopharynx, the mesopharynx and the hypopharynx failed to demonstrate any vestige of oil. A roentgenogram of the chest made five minutes after the spraying revealed that no oil was aspirated into the lung.

CASE 29.—A woman aged 31 had a nasal septum deflected to the right. There was no nasal obstruction. Both airways were open. The nasopharynx showed no adenoids. The tonsils had been removed; both pillars were preserved. The velum moved perfectly during phonation. No ephedrine was used. The head was tilted slightly forward, and with eight squirts a mixture of the medicated liquid petrolatum (50 per cent) and the iodized oil (50

per cent) was instilled in each nostril. Roentgenograms were made immediately, one-half, three and five and one-half minutes after the spraying.

No oil was demonstrated in the nasopharynx, the mesopharynx, the hypopharynx or the lungs.

CASE 30.—A woman aged 29 had a nasal septum slightly deflected to the right. The left airway was wider than normal. The nasopharynx disclosed no adenoids. The tonsils were out; both pillars were well preserved. The velum moved perfectly during phonation. The use of an ephedrine salt solution in each nostril created a wide breathing space on both sides.

With the head tilted forward, eight squirts of sesame oil (50 per cent) plus iodized oil (50 per cent) were applied in each nostril. Roentgenograms were made immediately, one-half, two and one-quarter, three and one-quarter and six minutes after the spraying.

No penetration of oil into the nasopharynx, the mesopharynx, the hypopharynx or the larynx could be discovered in spite of the shrinkage of the nasal mucous membrane through the action of ephedrine prior to the administration of the oil.

REPORT ON ONE CASE WITH TEN SQUIRTS IN EACH NOSTRIL

With Head Held Straight.

CASE 31.—A man aged 49 had a congested right inferior turbinate. The septum was straight, and the left airway was wide open. After administration of an ephedrine salt solution both airways were wide open. The tonsils were enlarged. The velum moved perfectly during phonation. The head was held straight, and ten squirts of a mixture of the medicated liquid petrolatum (50 per cent) and the iodized oil (50 per cent) were applied in each nostril. Roentgenograms were made twenty-five seconds, seventy seconds, three and three-quarters and six minutes after spraying.

The nasopharynx, the mesopharynx, the hypopharynx, the larynx and the lungs were shown to be absolutely free of aspirated oil.

SUMMARY

These experiments with massive doses of eight and ten squirts of oil in each nostril prove that when the head is held straight or tilted forward during and after the administration of the oil there is no danger that the oil will be aspirated (irrespective of the use of ephedrine in saline solution prior to the oil spraying).

CONCLUSIONS

A careful roentgenographic study made to determine the mechanism of the transmission of intranasally sprayed oils from the upper to the lower respiratory tract in apparently normal persons from 6½ to 66 years of age yielded conclusions as follows:

1. Healthy persons, irrespective of age, might aspirate oil (primarily when sprayed) even in therapeutic dosage if the oil is improperly administered.

2. The presence or the absence of tonsils and adenoids and the use of a 1 per cent solution of an ephedrine salt prior to the administration of oil apparently do not increase the danger of oil aspiration.

3. Scarring in the tonsillar beds and injury to the posterior pillars after tonsillectomy tend to increase the danger that oil will be aspirated if the oil is incorrectly administered.

4. Oil is carried downward by the force of gravity.

5. The decisive factor of safety or danger is the position in which the head is held during and after the administration of oil. The danger begins and increases with the size of the angle of the backward inclination of the head. There is no danger when the head is held straight or bent forward, ***even when massive doses many times the normal therapeutic dose are employed.*** The factor of safety increases with the size of the angle of the *forward* inclination of the head.

1100 Park Avenue.

STREPTOMYCES (ACTINOMYCES) ALBUS IN THE EAR

COLONEL STANLEY G. ODOM
MEDICAL CORPS, UNITED STATES ARMY

LIEUTENANT COLONEL ELMER J. RODENBERG
MEDICAL CORPS, ARMY OF THE UNITED STATES
AND
CAPTAIN PHILIP SCHAIN
MEDICAL ADMINISTRATIVE CORPS, ARMY OF THE UNITED STATES

In the routine examination of a patient in the clinic for diseases of the ear, nose and throat at the Station Hospital, Fort Hayes, a peculiar formation or growth in the external canal of the right ear was found. When a portion of this growth was subjected to bacteriologic examination, it was found to consist of colonies of Streptomyces albus, according to the recent classification of Waksman and Henrici.[1]

REPORT OF A CASE

The patient was a white man aged 38 years, born and reared on a farm in southern Ohio. He stated that the onset of his ear trouble dated back to December in the year 1932. At that time, while he was hunting rabbits, his right ear drum was perforated by a twig entering the ear when he suddenly turned his head to the right. On the same day he reported to his family physician, who instilled a weak solution of iodine into the canal. The patient stated that the iodine ran into the throat and caused vomiting. About one week later there developed a heavy yellow discharge from the ear. The ear was treated by various irrigations, instillations and insufflations through January and February 1933, at the end of which time it ceased to drain, and no discharge was noted thereafter.

In July 1934 the patient enlisted in the medical department of the Army, at which time a small perforation was noted in the tympanic membrane. No drainage, no impairment of hearing was noted. In December 1934 he was treated for acute coryza, at which time the ear became painful. He stated that the right eustachian tube was inflated and that the pain soon subsided without further incident. In 1935 he had an attack of influenza, which appears to have had no effect on the ear. No mention was made in the record as to involvement of the ear at that time. In 1939 the small perforation of the drum with normal hearing was again noted. In July 1941 a routine physical examination of the patient disclosed the fact that the hearing had dropped to 8/20 in the right ear, the left being normal. In August 1942 a large perforation of the right drum and chronic suppurative otitis media were noted. In March 1943 the patient was reexamined, at which time the findings were as follows: The right ear revealed a large perforation involving the lower anterior quadrant of the tympanic membrane; the upper and the posterior part, together with the malleus and Shrapnell's membrane, remained intact. The malleus was markedly retracted medially and posteriorly, and the opening of the eustachian tube was visible. The middle ear was seen to contain a small amount of moisture, which was shown by direct smear to be purulent. In the external canal there were a number of chalk-white colonies about 0.5 to 1 mm. in diameter, appearing like small half moth balls along the floor. On an attempt to make a smear of these nodules, it was found that they were so tenacious and of such firm consistency that they could not be disintegrated but could only be lifted out in toto when pressure was applied with a platinum loop. The left drum was normal. The hearing loss by audiometer was 54.6 per cent on the right side with no loss on the left. The nose was essentially normal. The teeth were in excellent condition. The tonsils had been removed. The remainder of the physical examination gave negative results. Roentgen examination showed the mastoid sinus on the right side partially sclerosed, whereas that on the left was entirely clear. Likewise, the chest was entirely clear.

1. Waksman, S. A., and Henrici, A. T.: The Nomenclature and Classification of Actinomycetales, J. Bact., to be published.

Bacteriologic Study.—Microscopically the colonies when crushed between two slides and examined wet under sodium hydroxide consisted of branching, treelike filaments, varying from 0.5 to 0.8 micron in diameter. Stained by Gram's stain, the preparation showed occasional gram-positive cocci and bacilli and numerous gram-positive filaments without clubbed ends, arranged in branch formation and singly. Of the latter, many were irregular in shape, taking the form of the diphtheria bacillus and that of Bacillus bifidus. None of the forms retained the acid-fast stain.

The cultural characteristics were as follows: After twenty-four hours at 37 C. an aerobic culture on dextrose blood agar showed small brownish gray colonies varying in size from 0.3 to 0.7 mm. in diameter. They were dull, round, raised granular bodies of such firm

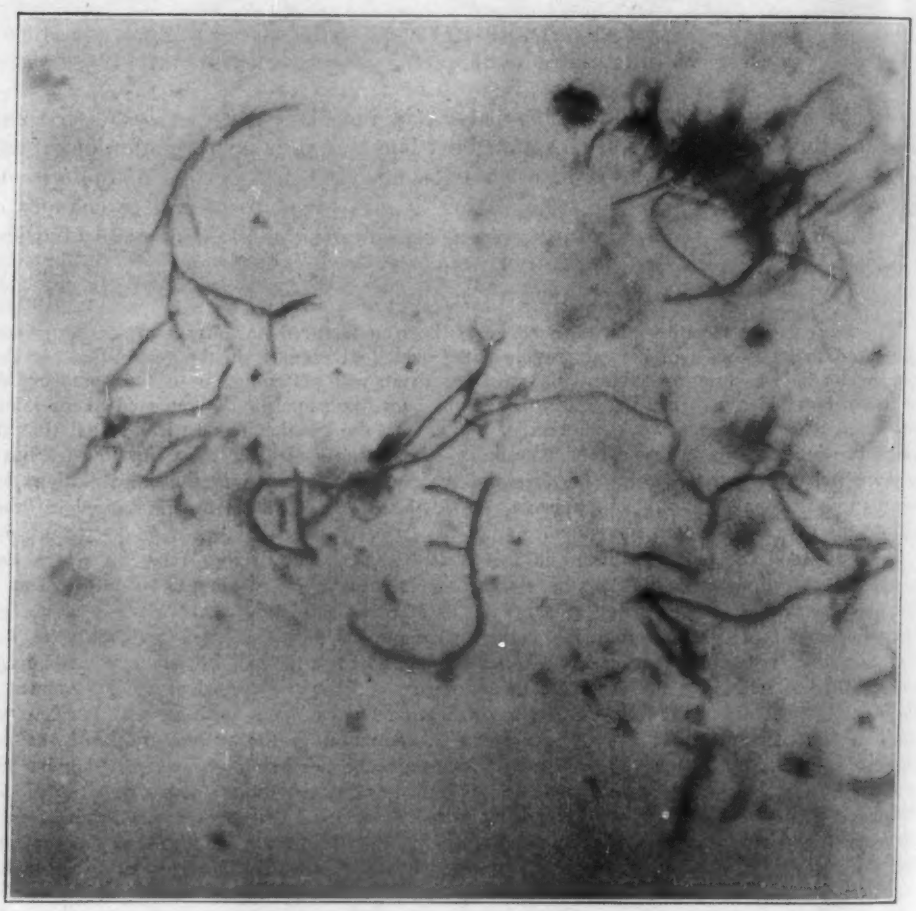

Fig. 1.—Streptomyces albus from a dextrose blood agar plate; × 1,000.

consistency that, as in the ear, they could be removed from the plate only in their entirety by lifting some of the underlying medium to which they clung tenaciously.

Smears prepared from the crushed colonies revealed the same picture as the smears prepared directly from the growth in the ear; that is to say, gram-positive, non-acid-fast cocci, bacilli and nonclubbed filaments arranged singly and in true and false branching formations (fig. 1). Observed over a period of one week, the culture showed the following changes: The size of the colonies increased only slightly, but the brownish gray color of most of them was gradually diffused with a chalk-white powder layer of growth (fig. 2), which microscopically consisted of filaments and could be easily removed from the underlying tough brownish gray colonies by gentle scraping. This layer started at the lower periphery of the colony and gradually extended upward to the apex, in some cases covering it completely

so that it was identical in appearance with the growth seen in the ear itself. Occasionally colonies were seen which were crater-like, worm cased and heaped up, resembling the R colonies of tubercle bacilli, as well as shiny yellowish colonies resembling some of the anaerobic forms. It was noted that on dextrose blood agar slants the shiny yellowish colonies predominated in the lower, moist portion of the medium while the white colonies constituted the majority in the upper, dry part of the slant (fig. 3).

On dextrose blood agar shake culture, colonies were present only on the surface of the medium. Anaerobically there was no growth in seven days.

Dextrose agar cultures without blood showed essentially the same type of growth as those with blood except that the colonies were gray-white instead of brownish gray. On dextrose

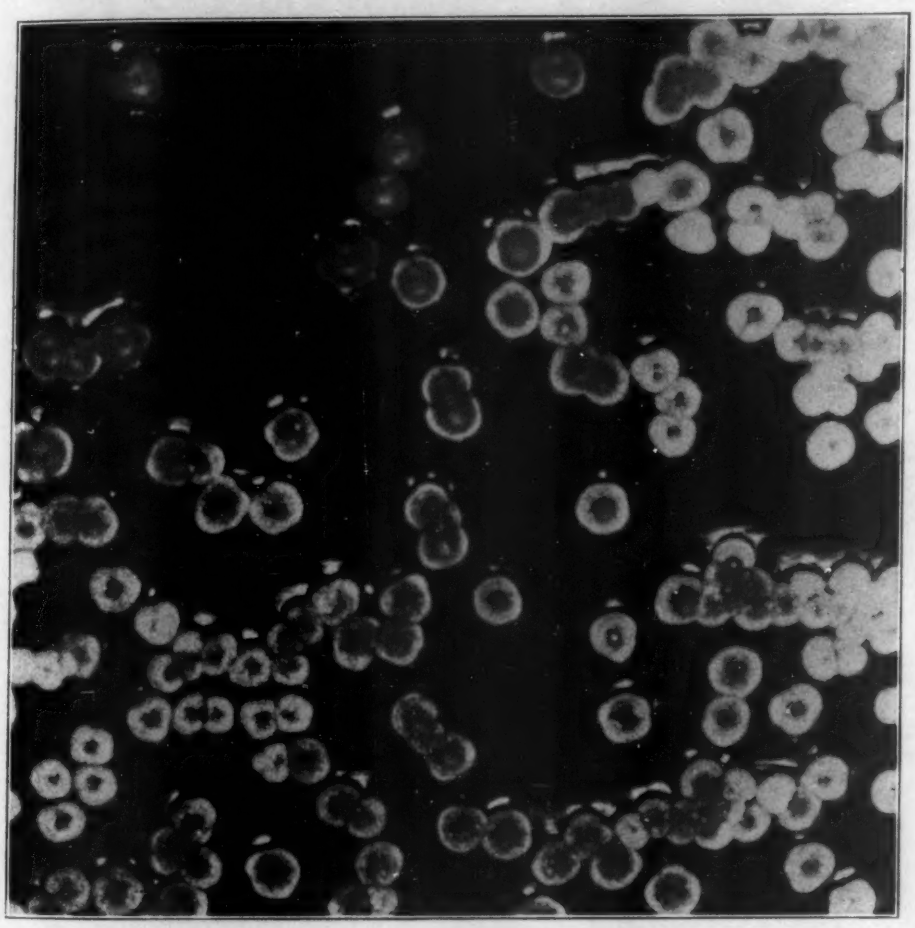

Fig. 2.—Streptomyces albus on a dextrose blood agar plate, showing shiny yellowish colonies and various stages of coverage by the white powdery growth; × 3.

broth culture observed over a period of seven days, no growth was apparent on the surface or throughout the medium. At the bottom of the tube, however, a number of brown colonies with dark centers and lighter peripheries, ranging in size from 0.3 to 2 mm., were seen. Shaking the tube changed neither the clarity of the medium nor the contour of the colonies. Smears from one of these colonies were identical with those of the agar plate colonies except that more filaments were found singly at the periphery, and in masses at the center, than in branching formation (fig. 4).

Bactericidal Tests in Vitro.—(*a*) Roentgen rays: Three day old colonies in an open plate culture were exposed to 200 r, with no filter, at 85 kilovolts and 30 cm. focal distance. This

was repeated after thirty-six hours, after which transplants were made on fresh mediums. There was no inhibition of the growth of organisms so treated.

(*b*) Thymol: A 10 per cent solution of thymol in olive oil was allowed to remain in contact with colonies at 37 C. over a period of one week. At intervals of four hours, twenty-four hours, forty-eight hours and seventy-two hours and thereafter at twenty-four hour intervals up to one week, a colony was removed from the slant and was washed free of thymol by crushing it in a tube of saline solution, centrifuging and discarding the supernatant fluid. The washing procedure was repeated twice, and the sediment of filaments was inoculated on half of a dextrose blood agar plate. As controls, colonies treated with plain olive oil,

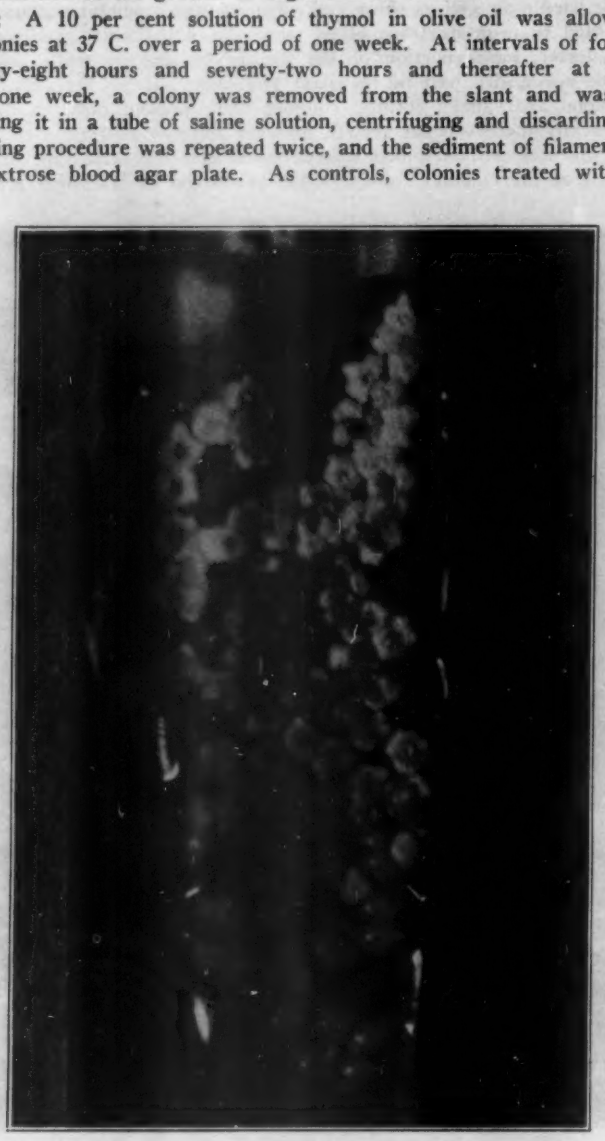

Fig. 3.—Streptomyces albus from a dextrose blood agar slant, showing white colonies on the upper, dry part of the slant and yellowish shiny colonies in the lower, moist portion; × 3.

without thymol, were carried through the same timing and washing procedures and the sediment inoculated on the other half of the plate. After four hours' contact with thymol the colony transplanted grew just as well as the control that had been treated with plain olive oil. After twenty-four hours' contact with thymol the transplant gave rise to a few scattered colonies in seventy-two hours, compared with a twenty-four hour luxuriant growth of the control colony. After forty-eight hours of treatment only four colonies developed from the thymol-treated culture, compared with a heavy growth of the control. At the end of seventy-two hours' contact only one colony developed from the thymol-treated culture, and it did not make its appearance until after three days' incubation. Subsequent transplants made after four, five, six and seven day periods of contact with thymol showed no evidence of growth after

seven days of observation at 37 C., compared with a twenty-four hour luxuriant growth of the plain olive oil–treated cultures.

Bactericidal Tests in Vivo.—After six days of treatment with 10 per cent thymol in olive oil, cultures were made of material from the patient's ear, which were negative macroscopically. The twenty-four and forty-eight hour cultures showed only Staphylococcus albus, but on the third day very small colonies of Streptomyces appeared, and after four days the colonies appeared as typical forms, no less numerous than those from the untreated ear. Another smear and culture were made after sixteen days of treatment. The former showed typical branching filaments which had lost their ability to retain the Gram stain, but the culture showed no evidence of growth. Cultures made from the middle ear, however, still showed many colonies of Streptomyces.

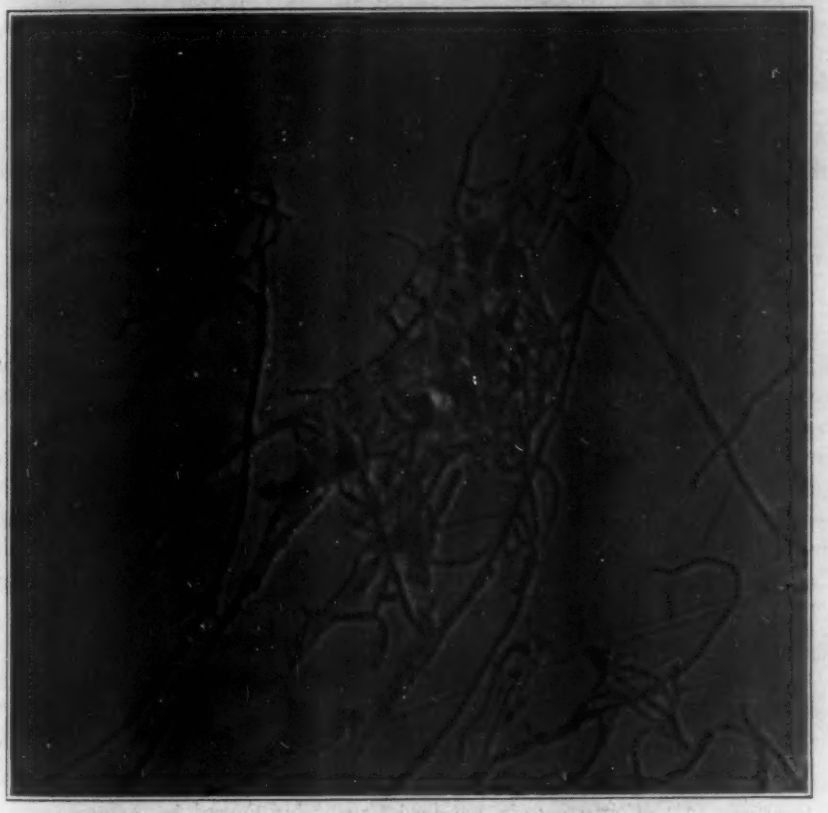

Fig. 4.—Streptomyces albus from a dextrose broth culture, showing a tangled mass of filaments; × 1,000.

Three weeks after treatment had been discontinued, a number of white colonies were again seen in the inner aspect of the floor of the canal, the smear and culture from which differed in no way from those seen at the original examination, made three months earlier.

LITERATURE

Although numerous cases of actinomycosis have been recorded in the literature, the vast majority were cases in which the lesion was found in and about the mouth, the pharynx and the lungs. The few cases of aural involvement appear to have been mostly instances of secondary infection by direct extension from these areas. Nowhere could there be found the report of a case in which the herein described acid-fast, unclubbed, aerobic type of organism had primarily infected the ear.

Cann and Hollis [2] reported a case of actinomycosis concerning which they expressed the belief that the primary focus was in the middle ear, the drum membrane being intact and the mastoid cells free from involvement. The patient died of actinomycetic meningitis and at autopsy was found to have a large collection of pus in the tympanic cavity. The latter finding was accepted as proof that the middle ear was the primary site of infection. In the same review they cited Henry Herbert as having collected from the literature 25 similar cases. Nowack [3] reported that he had treated 32 persons for the disease between 1930 and 1938. In only 2 of these had the ear been involved and in both the infection terminated in meningitis. Nehmer [4] published a report of a case of actinomycosis of the petrous portion of the temporal bone in which he expressed the belief that the primary lesion was a traumatic actinomycetic infection of the right half of the face which progressed via the mouth, eustachian tube and middle ear to the petrous bone. An abscess of the temporal lobe developed, and the disease terminated in meningitis. Hagedorn,[5] Kalt,[6] Thies,[7] Zimmermann [8] and others have recorded cases of actinomycosis involving regions such as the lacrimal apparatus, the eye, orbital structures and the face, but Ballenger's [9] statement as to the rarity of actinomycosis of the middle ear and the sparsity of literature on the subject is borne out. Most reports of aural involvement fail to describe the exact species of Actinomyces present, and none mention Streptomyces albus.

TREATMENT

In general the treatment of patients for actinomycosis has not been highly successful, and that for involvement of the ear appears to have been especially unsatisfactory. Among the various measures employed are surgical procedures, roentgen therapy, radium, administration of copper sulfate, iodides and thymol. Walker [10] recently reported the use of sulfanilamide with some indication of success. Autogenous vaccine [11] and vaccine combined with colloidal gold [12] have been recommended. Fowler [13] stated that surgical treatment may be successful when the disease has invaded the mastoid process, but that healing is slow and may be incomplete. The fungicidal activity of certain volatile oils, including thymol, has been pointed

2. Cann, L. W., and Hollis, G. S.: Case of Actinomycotic Cerebro-Spinal Meningitis Associated with Aural Actinomycosis, Lancet **1**:130-131 (Jan. 17) 1931.

3. Nowack, A.: Ueber die in den Jahren 1926/38 beobachteten Aktinomykosefälle an der Hals-, Nasen- und Ohrenklinik der Charité, Ztschr. f. Hals-, Nasen- u. Ohrenh. **43**:416-418, 1938.

4. Nehmer, W.: Ueber eine zentrale Aktinomykose des Felsenbeins, Ztschr. f. Hals-, Nasen- u. Ohrenh. **41**:320-328, 1937.

5. Hagedorn, A.: Concretions in Lacrimal Canaliculus Caused by Actinomycosis, Arch. Ophth. **23**:689-692 (April) 1940.

6. Kalt, E.: Actinomycose faciale et orbitaire, Bull. Soc. d'opht. de Paris **51**:167-169 (March) 1939.

7. Thies, O.: Aktinomykose des Sehorgans, Klin. Monatsbl. f. Augenh. **86**:55-58 (Jan.) 1931.

8. Zimmermann, H. B.: Localized Actinomycosis, Minnesota M. J. **14**:75-79 (Jan.) 1931.

9. Ballenger, W. L., and Ballenger, H. C.: Diseases of the Nose, Throat and Ear, Philadelphia, Lea & Febiger, 1938, p. 502.

10. Walker, O.: Sulphanilamide in Treatment of Actinomycosis, Lancet **1**:1219-1220 (May 28) 1938.

11. Payr, E.: Zur Diagnose und Behandlung der Aktinomykose Autovakzinetherapie, München. med. Wchnschr. **80**:1001-1003 (June 30) 1933.

12. Neuber, E.: Neuere Untersuchungen und Beobachtungen in bezug auf Diagnose und Behandlung der Aktinomykose, Wien. klin. Wchnschr. **51**:12 (Jan. 7); 48 (Jan. 14) 1938.

13. Fowler, E. P., Jr.: Medicine of the Ear, New York, Thos. Nelson & Sons, 1939, p. 185.

out,[14] and in 1937 Myers [15] reported cases in which the use of thymol locally and systemically was resorted to. Five of the patients recovered, while one who refused to take thymol internally died of visceral actinomycosis, although the original lesion (in the groin) healed with local use of the drug. It is of interest to note that Florey and Florey [16] included in their recent report the unsuccessful use of penicillin in the treatment of 2 patients with actinomycosis.

The patient whose case is herein reported, as shown in foregoing paragraphs, was treated with thymol. Of course it was not possible to maintain the same concentration and intimate contact in the ear as in the test tube, but it was hoped that with a longer period of treatment of the middle ear a somewhat comparable result might be achieved. The medication was applied by cotton applicator twice daily for a period of sixteen days, the result of which is shown elsewhere in this paper.

COMMENT

It is recognized that Streptomyces albus and related strains are found normally living on grains and grasses and abundantly in the soil and that they often gain access to the mouth and respiratory passages of man, where they act as saprophytes. However, like the anaerobic forms more commonly found in actinomycosis, they have often been found to be pathogenic in man and animals.[17] In this case it is presumed that the twig mentioned in the history harbored the organism, which gained entrance into the ear by direct contact and was able to establish itself, perhaps because of injury to the tissues. Although the patient had not been aware of an aural discharge since 1933, there was here nevertheless a low grade chronic suppurative otitis media in which considerable deterioration of auditory function had been noted during the past two years. While it cannot be stated that these changes were due to the presence of Streptomyces albus, certainly the circumstances are such that this possibility cannot be entirely ignored.

SUMMARY

Streptomyces albus was isolated in pure culture from an ear involved in a disease resembling the ordinary type of chronic suppurative otitis media. The organism had firmly established and maintained itself in the middle ear over a period possibly as long as ten years.

Although actinomycosis ordinarily is associated with the anaerobic species of Actinomyces, aerobic species such as the one here isolated have often been found to be pathogenic in man and animals.

While playing an uncertain role in the pathologic process observed, the presence of the organism here must be regarded with due caution.

14. Myers, H. B., and Thienes, C. H.: The Fungicidal Activity of Certain Volatile Oils and Stearoptens, J. A. M. A. **84**:1985-1986 (June 27) 1925. Myers, H. B.: Unappreciated Fungicidal Activity of Certain Volatile Oils, ibid. **89**:1834-1836 (Nov. 26) 1927.

15. Myers, H. B.: Thymol Therapy in Actinomycosis, J. A. M. A. **108**:1875 (May 29) 1937.

16. Florey, M. E., and Florey, H. W.: General and Local Administration of Penicillin. Lancet **1**:387 (March 27) 1943.

17. Waksman, S. A.: Personal communication to the authors, June 1943.

SOLITARY NEUROFIBROMA OF THE LARYNX

THOMAS T. SMITH, M.D.
PHILADELPHIA

Solitary benign tumors arising from peripheral nerves and possessing the characteristic picture of neurofibroma have been observed in almost all parts of the body but occur most frequently along the posterior divisions of the spinal nerves and the acoustic nerve and less commonly along other cranial nerves.

The occurrence of a tumor of this type in the larynx, however, is extremely rare, only 12 cases having been reported. Five cases were found in American literature, and 7 in foreign publications. Vail,[1] describing a case of schwannoma of the larynx in 1933, noted only 2 previously reported similar cases. Suchanek[2] reported a case in 1925, and Holmgren and Borgstrand,[3] another in 1928. Jackson and Coates[4] described a single case in 1929. Malan[5] in 1937 reported a case and referred to similar single cases described by Clause, Marshik and Gignoux, respectively. New and Erich[6] in 1938, Hoover[7] in 1940, Seidel[8] in 1940 and Van Loon[9] in 1942 reported similar cases. Because the laryngeal manifestation of generalized neurofibromatosis is considered a separate entity, cases of that condition are not included in this report.

During the past decade 3 patients with solitary laryngeal neurofibroma have been observed and treated in the bronchoscopic department of Jefferson Hospital.

REPORT OF CASES

CASE 1.—T. H., a 6 year old white boy, was admitted to the Jefferson Hospital on March 8, 1942. The parents stated that he had been troubled with dyspnea on slight exertion for the past eight months. This was gradually becoming more marked. The familial and the personal medical history were irrelevant.

Physical examination on admission showed a fairly well developed but thin child who became dyspneic on slight exertion. Mirror laryngoscopy revealed a large round smooth tumor occupying the entire right side of the pharynx, displacing the larynx to the left and markedly narrowing its lumen (fig. 1 *A*).

Direct laryngoscopy disclosed a firm tumor arising from the right side of the larynx. It exhibited no signs of inflammation. There were no other abnormal findings. Roentgenologic studies corroborated the clinical findings.

From the Department of Laryngology and Broncho-Esophagology, Jefferson Hospital.

Thesis submitted to the Faculty of the Graduate School of Medicine, University of Pennsylvania, toward the requirements for the degree of Master of Medical Science (M. Sc. Med.) for graduate work in otolaryngology, bronchoesophagology and laryngeal surgery.

1. Vail, H. H.: Schwannoma, Ann. Otol., Rhin. & Laryng. **42**:476, 1933.

2. Suchanek: Neurinom des Kehlkopfeinganges, Monatschr. f. Ohrenh. **59**:613, 1925.

3. Holmgren, G., and Borgstrand, H.: Neurinoma: Case Report, Acta oto-laryng. **12**: 514, 1928.

4. Jackson, C., and Coates, G. M.: The Nose, Throat and Ear and Their Diseases, Philadelphia, W. B. Saunders Company, 1929.

5. Malan, A.: Neurinoma, Valsalva **13**:417, 1937.

6. New, G. B., and Erich, J. B.: Benign Tumors of Larynx: Study of 722 Cases, Arch. Otolaryng. **28**:841 (Dec.) 1938.

7. Hoover, W. B.: Benign Tumors: Diagnosis and Treatment, S. Clin. North America **20**:697, 1940.

8. Seidel, O.: Very Rare Tumor (Neurinoma) of Unusual Size in Boy Twelve Years Old, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **148**:210, 1940.

9. Van Loon, E. L., and Diamond, S.: Neurofibroma of Larynx, Ann. Otol., Rhin. & Laryng. **5**:122, 1942.

On May 22, 1942, with the patient under anesthesia induced with solution of tribromoethanol U. S. P. and ether and after a preliminary low tracheotomy, removal was accomplished. The tumor was exposed through a lateral approach along the anterior border of the right sternocleidomastoid muscle and was found to arise from the right aryepiglottic fold. It was relatively smooth and was surrounded by a distinct capsule which was not adherent to the surrounding structures. Since the pharynx was not opened, it was readily shelled out (fig. 1 *B*). The wound was closed without drainage. Following a normal convalescence, the patient was decannulated. The voice rapidly returned to normal, and there was no further difficulty in breathing. One month later examination of the larynx showed some residual edema of the right arytenoid and aryepiglottic fold, but the motility was normal and the airway adequate. Since discharge of the patient, the voice has remained normal, and repeated laryngeal examinations have revealed no recurrence.

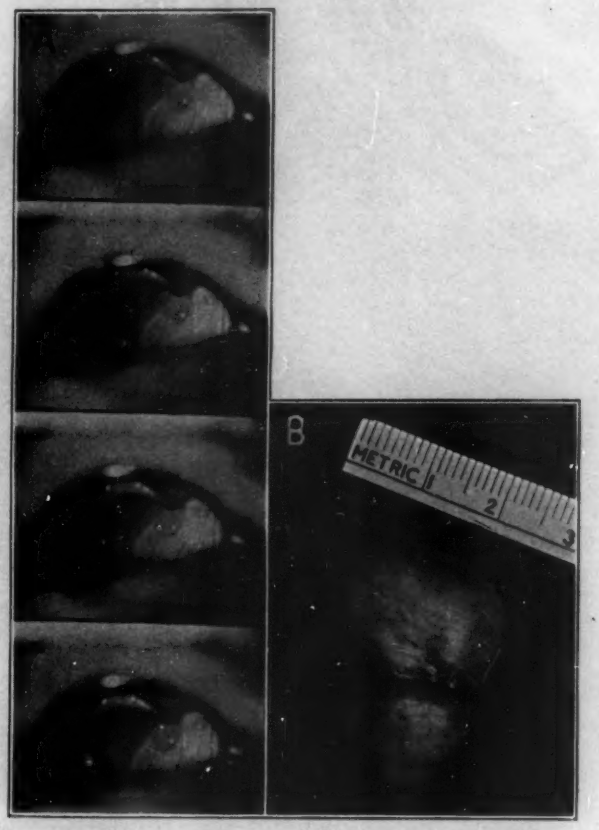

Fig. 1 (case 1).—*A*, enlarged prints made from a 16 mm. kodachrome cinematograph taken by mirror laryngoscopy, showing the tumor occupying the right side of the larynx. *B*, tumor removed, which measured 3 by 1.5 by 0.5 cm. It was firm and well encapsulated.

The pathologic report by Dr. C. J. Bucher was as follows: "The tumor is rather nodular, smooth, glistening, yellowish pink and quite firm. It measures 3 by 1.5 by 0.5 cm. The cut surface discloses compact amorphous grayish white tissue. There is a distinct capsule. Histologically, the tissue is made up of dense fibrous tissue, which in some areas is arranged in whorls. The nuclei are elongated and hyperchromatic, and in areas tend to be arranged in palisades (fig. 2). The diagnosis is neurofibroma."

Case 2.—A. D. B., a 26 year old white man, was admitted to the bronchoscopic clinic of the Jefferson Hospital on July 31, 1933. He complained of marked hoarseness, some discomfort of the throat and persistent cough. There was no dyspnea. These symptoms began about four years previously and became progressively worse. The familial and the personal medical history were not relevant.

Mirror laryngoscopy revealed a large globular mass springing from the left ventricular band. Direct laryngoscopy revealed a firm mass extending downward, forward and inward, encroaching on the glottic chink. The entire left ventricle was obliterated, and the left vocal cord was displaced downward. The mucosa over the mass was intact.

Laryngofissure was performed on Aug. 1, 1933, with the patient under local anesthesia. The left ventricular band was found to be displaced forward, inward and downward, obliterating the ventricle and obscuring the left vocal cord. The tumor was firm and somewhat lobulated, and exhibited no inflammatory changes. Incision through the mucosa revealed definite encapsulation, allowing easy removal by blunt dissection (fig. 3 *A*). After slight bleeding was controlled, the larynx was closed in the usual manner.

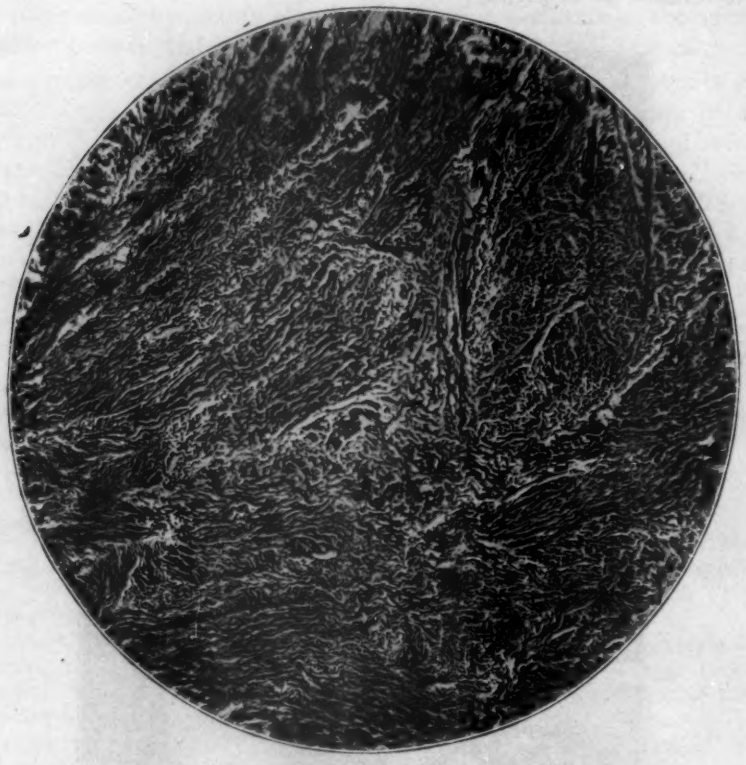

Fig. 2. (case 1).—Photomicrograph (× 100) showing the dense fibrous character of the tumor, with elongated nuclei arranged in streams and fasciculi.

Recovery was uneventful. One week after operation, mirror laryngoscopy showed some residual inflammatory reaction with fixation of the left side of the larynx. The right vocal cord and the remaining portion of the larynx appeared normal, and the airway was ample. Subsequent examinations showed continued fixation of the left side with some scarring. The airway and the voice have remained normal, and there has been no recurrence of the tumor.

The pathologic report by Dr. C. J. Bucher was as follows: "The specimen consists of a somewhat oval-shaped encapsulated nodule, measuring 3 by 2.5 by 2 cm. Cut surfaces are solid and composed of a rather soft but tough gray tissue containing small hemorrhagic areas. Microscopic examination reveals numerous small cellular areas in which the nuclei are large and have a palisade arrangement. In some areas the fibers are arranged in whorl formation. In other areas the connective tissue is edematous and contains numerous small blood vessels and small hemorrhages. The diagnosis is neurofibroma of the larynx." (Fig. 3 *B*.)

Case 3.—T. B. M., a 6 year old white boy, was admitted to the bronchoscopic clinic of the Jefferson Hospital on June 7, 1937. The parents stated that for the past few months the child had been troubled with wheezing and a moderate inspiratory stridor on slight

exertion. At such times a persistent distressing nonproductive cough would also appear. The child's health had been excellent and growth and activity normal until the present difficulty arose. There was no history of childhood diseases. The family history was negative.

Direct laryngoscopy revealed a large, irregularly lobulated mass springing from the left ventricular band and the left arytenoid area. This extended forward, overhanging the airway and making it difficult to secure a satisfactory view of the glottic chink. Twelve days later, after a preliminary tracheotomy, laryngofissure was performed. When the larynx was opened, an irregular papillary growth was found extending from the posterior part of

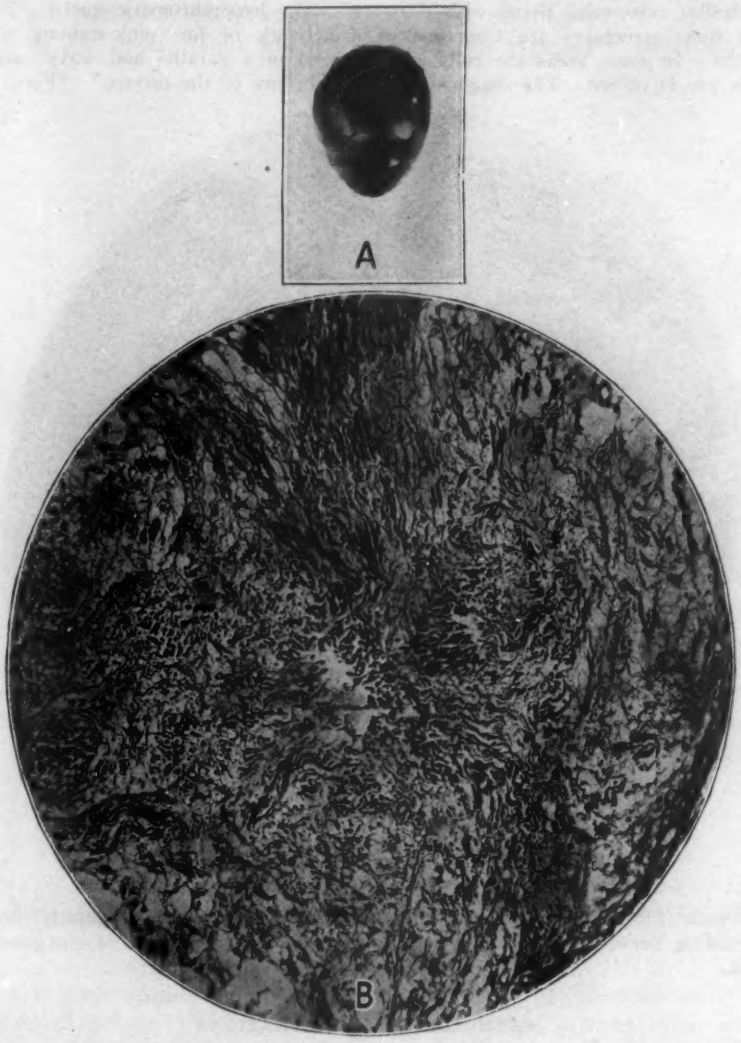

Fig. 3 (case 2).—*A*, actual size photograph of tumor removed by laryngofissure. It measured 3 by 2.5 by 2 cm.

B, photomicrograph (× 100) showing elongated cells and fiber bands arranged in a palisade manner. The remaining tissue is reticulated with fewer fibers and much intercellular fluid.

the left ventricular band into the interarytenoid area and up into the left aryepiglottic fold. All of the tissues involved were removed, and the larynx was closed in the conventional manner.

Recovery was uneventful. One month after operation, direct laryngoscopy showed only some distortion of the epiglottis with slight scarring of the left aryepiglottic fold. The

motility of the larynx and the voice were normal. The laryngeal airway was adequate. Repeated examinations have revealed no recurrence.

The pathologic report by Dr. B. L. Crawford was as follows: "The specimen consists of a somewhat ragged and irregular mass, measuring about 2.5 cm. in its greatest diameter. Histologically this shows normal squamous epithelium covering a connective tissue stroma which in some areas is dense and cellular and in others loose and edematous. Thin-walled capillaries are numerous throughout.

"Scattered throughout this stroma are round, oval and irregularly shaped structures which somewhat resemble nerve bundles. These are surrounded at the periphery by marginal layers of fibrillar connective tissue with elongated wavy hyperchromatic nuclei. The central portions of these structures are composed of a network of fine pink-staining fibrils connecting nuclei. In some areas the cells are arranged in a parallel and wavy manner. No nerve fibrils are identified. The diagnosis is neurofibroma of the larynx." (Figs. 4 and 5.)

Fig. 4 (case 3).—Photomicrograph (× 50) showing oval and irregularly shaped structures resembling nerve bundles. The supporting stroma is composed of elongated cells and fiber bands.

PATHOLOGIC CONSIDERATIONS

Histologically, these tumors are similar, and each is characteristic of neurofibroma. These characteristics are best synopsized by Ewing's [10] concise description. He stated that the tumor is covered by a distinct capsule, which he thought was distended epineurium. He described the growth as being made up of two kinds of tissue, the main tissue being fasciculated, with elongated cells and fiber bands arranged in a palisade manner, and the remaining tissue being reticulated with few fibers, irregularly scattered cells and much intercellular fluid lying in

10. Ewing, J.: Neoplastic Diseases, Philadelphia, W. B. Saunders Company, 1941.

vacuoles or forming small cysts containing mucinous material. The blood vessels in this tissue show characteristic hyaline thickening.

While this histologic picture seems characteristic, this tumor represents only one of a group of new growths arising from nerve tissue, the supporting structure of nerve tissue or both which are similar histologically but which differ greatly clinically. Because most classifications have been made on histopathologic appearances, it is understandable that considerable confusion should arise. A major factor in the confusion of terminology has been the highly controversial theories as to the specific tissue from which tumors of this type have their origin and the

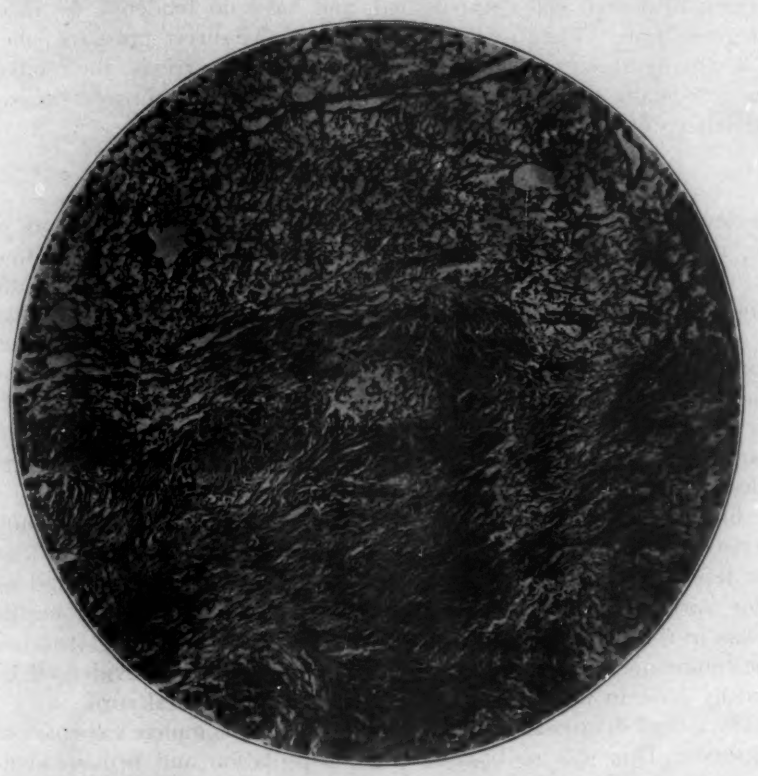

Fig. 5 (case 3).—Photomicrograph (× 100) of supporting stroma shown in figure 4. It is composed of elongated slender nuclei arranged in palisades with a tendency toward whorl formation.

tendency for each author to name the tumor which he observed after the supposed tissue of origin. Virchow [11] believed that these tumors arose from nerve tissue, but he described the type as false neuroma because he could not find nerve cells within these tumors. Almost four decades later Thomson [12] noted that there were single and multiple varieties. However, von Recklinghausen's [13] theory of a connective tissue origin was generally accepted until Verocay,[14] in 1910, offered

11. Virchow, R.: Die krankhaften Geschwülste, Berlin, A. Hirschwald, 1863.
12. Thomson, A.: Neuroma and Neurofibromatosis, Edinburgh, Turnbull and Spears, 1900.
13. von Recklinghausen, F.: Ueber die multiplen Fibrome der Haut und ihre Beziehung zu den multiplen Neuromen, Berlin, A. Hirschwald, 1882.
14. Verocay, J.: Zur Kenntnis der Neurofibrome, Beitr. z. path. Anat. u. z. allg. Path. 48:1, 1910.

evidence that the tumor was made up of nerve cells or their embryonal equivalents. He thus suggested the term "neurinoma." In substantiating Verocay's work Masson [15] advanced the thesis that the cells of the sheath of Schwann were the originating units and offered the term "schwannoma." However, Mallory,[16] Rhodes and Van Wagenen [17] and later Penfield [18] offered evidence that the tumor arose from neural connective tissue and that the type cell was a connective tissue cell. Thus arose a multitude of terms, such as "peripheral neurofibroma," "peripheral fibroblastoma," "perineural fibroblastoma," "peripheral glioma" and "neurilemmoma."

These single noncancerous tumors, designated by so many different terms, are usually quite firm and well encapsulated, and have no tendency to undergo cancerous degeneration. They tend only to destroy by direct pressure, and as their growth is usually slow and characterized by frequent arrests, their effect on the larynx is principally that of distortion. If the growth is entirely removed, there is no tendency toward recurrence.

CLINICAL CONSIDERATIONS

In reviewing these cases and those previously reported for which records were available, it is noted that tumors of the larynx of the type in question offer a symptom complex that is general for all noncancerous tumors affecting this organ. The symptoms vary from slight hoarseness and discomfort in the throat to disturbances in breathing, cough and dyspnea, according to the size and the location of the tumor. The interval between the onset of symptoms and the removal of the tumor in the cases analyzed varied from eight months to twelve years. The age of the patients at the time of removal varied from 6 to 50 years, with an average of 27.6 years. Both sexes were affected about equally, with a slight preponderance in females.

The findings on examination of the larynx were likewise not noted to be characteristic only of this type of tumor. However, the appearance of a firm, solid, more or less rounded, encapsulated tumor of the larynx was found suggestive. The color varied from gray to yellowish red. The usual site of location in the larynx was in the region of the ventricular band and the aryepiglottic fold. However, the tumor may appear in any portion of the larynx, as evidenced by the case described by New in which the tumor occurred on the vocal cord.

Usually a final diagnosis was not made until after complete extirpation had been accomplished. This was so because the encapsulation and firm makeup of these tumors make removal of tissue for biopsy exceedingly difficult if not impossible.

Surgical excision was the treatment of choice. The location of the tumor and its site largely determined the method of removal. Apparently the familiarity of the operator with various procedures was also a factor. In the cases reviewed

15. Masson, P.: Recklinghausen's Neurofibromatosis, Sensory Neuromas and Motor Neuromas, in Contributions to the Medical Sciences in Honor of Dr. Emanuel Libman by His Pupils, Friends and Colleagues, New York, International Press, 1932, vol. 2, p. 793; Am. J. Path. **8**:367, 1932.

16. Mallory, F. B.: The Type of Cell of the So-Called Dural Endothelioma, J. M. Research **41**:349, 1920.

17. Rhoads, C. P., and Van Wagenen, W. P.: Observations on the Histology of the Tumors of the Nervus Acusticus, Am. J. Path. **4**:145, 1928.

18. Penfield, W.: Tumors of the Sheaths of Nervous System, Arch. Neurol. & Psychiat. **27**:1298 (June) 1932; Cytology and Cellular Pathology of the Nervous System, New York, Paul B. Hoeber, Inc., 1932; The Encapsulated Tumors of Nervous System, Meningeal Fibroblastomata, Perineural Fibroblastomata and Neurofibromata of von Recklinghausen, Surg., Gynec. & Obst. **45**:178, 1927.

the tumor was removed by suspension laryngoscopy in 3, by direct laryngoscopy in 1 and by the external route in 7. All of the cases in my group were such that an external procedure was required. The tumor in Jackson's patient was not treated, because of coexisting cancer. There was one reported recurrence (Gignoux), in a case in which the tumor had been incompletely removed. The only sequela in most cases was a fixed homolateral cord. This occurred in 1 of my cases. In none of the cases reported did the tumor show cancerous degeneration.

SUMMARY

Solitary neurofibroma of the larynx is most apt to occur in the early decades of life. Males and females are affected about evenly. The symptoms produced are not characteristic but conform to those of any slowly growing noncancerous tumor of the upper part of the larynx. The laryngoscopic findings, likewise, are not diagnostic. However, a firm, single, encapsulated, grayish to yellowish pink tumor occupying the upper part of the larynx is suggestive of solitary neurofibroma. The usual site of origin is in the area of the ventricular band and the aryepiglottic fold.

Removal of tissue for biopsy is usually difficult or impossible. Hence the final diagnosis is rarely made until complete extirpation has been accomplished. Surgical excision is the treatment of choice.

Jefferson Hospital.

POSSIBLE VALUE OF NONTOXIC CONCENTRATIONS OF FLUORINE IN THE PREVENTION OF DEAFNESS FROM OTOSCLEROSIS AND FIBROSIS

ITS POSSIBLE VALUE IN PREVENTION OF OTHER DISEASES

ALFRED LEWY, M.D.
CHICAGO

The purpose of this paper is to present to members of the medical profession what I believe to be a promising and justifiable long range experiment in the use of fluorine for the prevention of some forms of deafness and to suggest investigations which may lead to its trial in other fields of medicine.

The influence of fluorine on living bone and fibrous tissue, especially ligaments, has been the subject of considerable investigation for many years. The literature on this subject was summed up by Roholm,[1] in 1937, in a monograph based on his study of cryolite workers and miners in Iceland. He has 893 bibliographic references. The dental literature [2] is also much concerned with dental fluorosis resulting from the drinking of water containing fluorine, and many investigations have been reported from various parts of the world. The effect extends to the dentin as well as to the enamel, hence the use of the term "dental fluorosis" instead of "mottled enamel," the term relating to the external visible sign (Schour and Smith [3]). It appears, further, that while toxic quantities of fluorine, variously estimated but approximating 2 parts or more per million in the drinking water, will produce dental fluorosis in children, there is a great lesseing of dental caries in such communities as have fluorine in their drinking water in less than toxic concentrations, say about 1 part per million, as compared with communities which have no fluorine at all in the water supply. The whole subject of the effect of fluorine on dental caries is summarized in a report of the Council on Dental Therapeutics by Harold C. Hodge, Ph.D.,[4] of the department of biochemistry and pharmacy of the University of Rochester School of Medicine and Dentistry, who claimed the reduction by one half of the incidence of new caries in children by the use of water containing 1 part per million of fluorine, in which concentration it is not toxic. The subject has been considered more recently by Ast.[5]

Investigations of the direct effect of fluorine on bacteria in the mouth by Bibby and Van Kesteren [6] indicate that a high and toxic concentration is necessary for

1. Roholm, K.: Fluorine Intoxication: Clinical Study with Review of the Literature and Some Experimental Investigations, English translation, London, H. K. Lewis & Co., Ltd., 1937.

2. Black, G. V., and McKay, F. S.: Mottled Teeth: An Endemic Developmental Imperfection of the Enamel of the Teeth, Heretofore Unknown in the Literature of Dentistry, Dent. Cosmos **58**:129, 1916. Dean, H. T., and others, in Fluorine and Dental Health, Publication 19, American Association for the Advancement of Science, 1942. Schour, I., and Smith, M. C.: The Histologic Changes in the Enamel and Dentin of the Rat Incisors in Acute and Chronic Experimental Fluorosis, Proc. Soc. Exper. Biol. & Med. **32**:1, 1934.

3. Schour, I., and Smith, M. C.: Experimental Dental Fluorosis, in Fluorine and Dental Health, Publication 19, American Association for the Advancement of Science, 1942.

4. Hodge, H. C.: Is Fluorine a Therapeutic Agent for Dental Caries? J. Am. Dent. A **29**:2063, 1942.

5. Ast, D.: The Caries-Fluorine Hypothesis and a Suggested Study to Test Its Application, Pub. Health Rep. **58**:857, 1943.

6. Bibby, B. G., and Van Kesteren, M.: Effect of Fluorine on Mouth Bacteria, Dent. Research **19**:391, 1940.

direct bacteriostatic action. It is evident that a preexisting change in the metabolism of the dental tissues is essential for the advent of caries, which is a bacterial process only in its terminal manifestations.

In 1928 I read a paper [7] before the American Rhinological, Laryngological and Otological Society, in which I attempted to show by feeding experiments that fluorine had an effect on the bony labyrinth, and in 1934 I reported to the American Otological Society further observations [8] in which I demonstrated a deposit of osteoid tissue on the wall of the labyrinth near the oval window. In the first-mentioned paper I made the suggestion that fluorine may have a therapeutic effect in otosclerosis and quoted Escat,[9] Schulz,[10] and Schüssler.[11] In this disease, which is subject to spontaneous fluctuations and even arrest, the normal course of which is over so long a span of years, the experience of no one man is sufficient to enable him to arrive at conclusions.

The demonstration that fluorine is preventive of dental caries and that this prevention is exercised by an effect on the metabolism of bone rather than by local bacteriostasis has awakened inquiry as to the possible value of fluorine in the prevention of deafness. I had promised Dr. Ernest M. Sydell during his presidency of the American Otological Society (1942) to present a paper comparing the incidence of deafness in communities having fluorine-containing drinking water with the average for other communities. This has not been practicable until now, when a survey of deafness in the school children of 68 of Illinois' 102 counties, under the supervision of Dr. Walter Theobald, is available. These tests were made with the group audiometer for screening out children with defective hearing. The children so discovered were then tested individually with the audiometer. This investigation has been considered in connection with a report of Dr. Charles F. Deatherage, head of the division of dental health education of the Illinois State Department of Health, covering 78 localities in 32 counties in the state.[12]

A total of 132,572 children were examined. Those with defective hearing numbered 6,328, an average for the state of 4.7 per cent.

In the counties whose water does not contain fluorine the total number of children examined was 109,869; the number with defective hearing was 5,406; the percentage defective was 4.9.

In four counties near Chicago whose drinking water contains fluorine not to exceed 1.4 parts per million, from which statistics were available, 20,488 children were examined; the number with defective hearing was 574; the percentage defective, 2.8. In Chicago alone 21,200 children were examined 922 of whom were found defective, a percentage of 4.3. Chicago drinking water comes from Lake Michigan and is fluorine free.

These numbers are sufficient to overcome to a large extent the elements of coincidence and of statistical error. The population of the four counties having fluorine in the drinking water from which statistics were available is varied.

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8. Lewy, A.: Influence of Fluorine on the Bony Labyrinth of the White Mouse: Further Observations, Arch. Otolaryng. **20**:693 (Nov.) 1934.

9. Escat, E.: Monographie, Otolaryng. Internat. **7**:653, 1922.

10. Schulz, H. P.: Vorlesungen über Wirkung und Anwendung der unorganischen Arzneistoffe, Leipzig, Georg Thieme, 1920.

11. Schüssler, W. H.: Manual for the Biochemical Treatment of Disease, translated by L. H. Tafel, ed. 25, Philadelphia, Boericke & Tafel, 1898.

12. Deatherage, C. F.: Mottled Enamel from the Standpoint of the Public Health Dentist (Including the Relation of Fluorine to Dental Caries in Illinois), in Fluorine and Dental Health, Publication 19, American Association for the Advancement of Science, 1942.

DuPage is largely a medium to high grade suburban residential district plus some farming districts; Will County is largely an industrial and mining district and contains the city of Joliet, with over 42,000 inhabitants; Kankakee is an industrial and farming community; Kendall County contains no large cities and is largely a farming district.

Much remains to be done with this idea. Wider investigation may upset it. A more detailed correlation of the defective persons as to family history and exact diagnosis is necessary. One cannot know how many potential otosclerotic or fibrotic ears are in the group. The few pairs of identical twins with a deafness heritage now being studied by Fowler [13] may offer an occasional opportunity for controls; study of blood serum calcium and phosphorus, and the effect of the serum of otosclerotic patients on labyrinthine bone (Grahe and Griebel [14]) might be extended to include the effect of fluorine on such bone as well as its effect on the endocrine system, especially the parathyroid glands.

Ast [5] proposed to test the accuracy of the fluorine-caries hypothesis by placing nontoxic doses of sodium fluoride (to equal 0.8 parts per million of fluorine) in the public drinking water of one community. The plan is to be studied ten or twelve years. Localities are to be selected so as to exclude variables as far as possible. The chemical composition of the water, past and present, the composition of the population as to size, color, nativity, age, sex and economic status, the geographic and climatic conditions, diet, and other conditions must be considered, and the same person or persons should conduct the investigation. In the same community the investigation could be extended to the question of deafness, and it could be appropriately done by the United States Public Health Service, the otosclerosis committee of the American Otological Society or any other authoritative body with proper facilities.

It is further suggested that internists and orthopedic surgeons may find here a fertile field for investigation of osteoarthritis and other diseases of the bone, beginning with a survey of the incidence of these diseases in localities which have fluorine in their drinking water in not too high concentration.

NOTE.—Since this article was submitted (Aug. 10, 1943) the April number of the *Journal of Laryngology and Otology* has become available (received Sept. 10, 1943) containing an article by Leo Spira, of London, England, in which he advances the idea that otosclerosis is a manifestation of fluorosis operating through the parathyroid glands.[15]

25 East Washington Street.

13. Fowler, E. P.: Otosclerosis in Identical Twins, Tr. Am. Otol. Soc. **32**:166, 1942.
14. Grahe, K., and Griebel, C.: Die Bedeutung der allgemeinen Stoffwechselstörung bei der Otosklerose, Ztschr. f. Laryng., Rhin., Otol. **22**:162, 1932; Weitere Abbaustudien bei Otosklerose, ibid. **24**:149, 1933.
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PLASTIC SURGERY IN FACIAL PARALYSIS

WITH MODIFICATIONS IN TECHNIC

EDWARD S. LAMONT, M.D.
HOLLYWOOD, CALIF.

The correction of permanent facial paralysis is frequently a reconstructive problem, often a neurologic one and sometimes both. At present war wounds are uppermost in mind; bizarre clinical pictures may be presented, and judgment must be applied according to present knowledge.

If the lesion is such that nerve graft or anastomosis can be accomplished, these procedures may be utilized. However, if the lesion is an old one, conjunctive surgical reconstruction with fascia and muscle transplants may be necessary. For, as Blair [1] pointed out, it requires six months to a year to obtain all or almost all of the innervation that can be obtained by anastomosis or nerve graft, but it requires a much longer period to learn to use this innervation to the greatest advantage. Consequently, in the presence of muscle atrophy, nerve graft or anastomosis alone will not affect a mechanical recovery.

ANATOMY OF THE SEVENTH NERVE

The seventh nerve leaves its motor nucleus in the pons varolii through a devious route and enters the internal auditory meatus. Here it lies adjacent to the auditory nerve and between them is found the sensory portion of the seventh nerve. Within the internal auditory canal the nerve runs laterally and the motor and sensory roots join. At the terminus the nerve enters the facial canal and inclines forward above the vestibule of the internal ear where its sensory division enters into the formation of the geniculate ganglion. It now bends and proceeds slightly posteriorly, passing behind the middle ear and out of the skull through the stylomastoid foramen (fig. 1).

The nerve proceeds anteriorly around the lateral side of the styloid process and the internal jugular vein, entering into the posterior medial surface of the parotid gland. Previous to its entrance into the gland, it sends off the posterior auricular nerve and a bifurcating branch supplying the stylohyoid muscle and the posterior belly of the digastric muscle. In its passage through the parotid gland, it separates into five divisions: temporal, zygomatic, buccal, mandibular and cervical. These branches supply all the muscles of the face except those of mastication, which are supplied by the trigeminal nerve: the temporal, the masseter, the external and the internal pterygoid muscles and the anterior belly of the digastric muscle.

The geniculate ganglion is in communication with the sphenopalatine ganglion through the greater superficial petrosal nerve and with the tympanic plexus through the lesser superficial petrosal nerve. Between the geniculate ganglion and the stylomastoid foramen the seventh nerve gives off the stapedial nerve, the chorda tympani and a communicating branch to the auricular branch of the vagus nerve.

From the Division of Reconstructive Plastic Surgery, Cedars of Lebanon Hospital.

Presented at the neurologic meeting of the Los Angeles County Medical Association in conjunction with colored surgical motion picture on Feb. 17, 1943.

1. Blair, V. P.: Notes on the Operative Correction of Facial Palsy, South. M. J. **19**: 116-120 (Feb.) 1926.

DIAGNOSIS OF THE LESION

From clinical manifestations of the lesion and a knowledge of the anatomy the exact location of the lesion may be determined. A cerebral insult in the pathway of the seventh nerve presents upper motor neuron disease with accompanying initial spastic paralysis. A lesion in the pons, depending on its location, will result in involvement of the pyramidal tract on the same or the opposite side. Should the medulla be involved, there may be associated paralysis of the abducens nerve. Further, injury below the nucleus results in a lower motor neuron type of paralysis. If it is in the internal auditory canal, proximal to the geniculate ganglion, the auditory nerve is usually affected.

From the previous anatomic discussion it is manifest that the degree of paralysis will depend on the location of the lesion. For example, if it is in the area of the geniculate ganglion, the paralysis will involve the stapedial nerve, the chorda tympani and all the terminal branches of the facial nerve; whereas, if the lesion

Fig. 1.—A dissection of the temporal bone. A probe is seen in the facial canal extending up from the stylomastoid foramen immediately posterior to the middle ear. The semicircular canals (superior, posterior and lateral) are demonstrated. All of the mastoid cells (zygomatic, petrous tip, dural, etc.) have been removed exposing the contour of the lateral sinus.

The anatomy of the surgical approach for either grafting of the seventh nerve in the canal or rerouting its course is depicted.

occurs between the stylomastoid foramen and the point where the nerve enters the parotid gland, all of the branches proximal to that point will be spared. As a rule pathologic change occurs in the geniculate ganglion, due to toxemia or exposure to cold or within the facial canal as a result of mastoiditis or the operation. Accompanying such a lesion, the following picture is depicted: The forehead does not wrinkle on the affected side (owing to the seventh nerve crossing over, and a lesion distal to the nucleus catches all the fibers); the eye remains open with accompanying lacrimation; the patient cannot blow out the cheek, and food catches in the mouth; there is a defect of speech, because the opposite side of the face is overacting and the mouth is pulled over accordingly. Paralysis of the stylohyoid muscle and of the posterior belly of the digastric muscle depresses the

tongue. Involvement of the chorda tympani results in the absence of taste from the anterior two thirds of the tongue on the affected side.

INDICATIONS FOR THE CHOICE OF OPERATION

The type of operation to be selected should depend on the clinical findings. If the lesion is central, the choice will obviously be limited; if it is peripheral, the following operation or combination of operations may be attempted: decompression, suturing of the nerve, anastomosis, nerve grafting, cervical sympathectomies or reconstructive operation. It is of initial importance that evaluation of the case be done early by a surgeon or a seminar of surgeons familiar with the course of the paralysis and the clinical results of each of the operations, so that they may be applied to the specific case under scrutiny.

Though some work had been done previously, relative to nerve suturing and anastomosis in facial paralysis, that accomplished by Ballance and Duel [2] was classic. In their animal and clinical experiments they concluded that anastomosis between the facial and other motor nerves was handicapped by the ever present associated movements. In their experiments they finally arrived at the method of using a degenerated portion of the anterior femoral cutaneous nerve as a nerve graft. When this operation was done early, they found their results gratifying.

In separate reports Duel and Tickle [3] and Ballance [4] stated that heteroplastic grafts could be used as long as the patients had the same blood grouping. Further, that though a nerve graft might be bathed in infection, apparently the latter was not a contraindication to the surgical procedure.

Martin [5] reported reasonable success in end to end suturing of the nerve within the canal and implantation of grafts where necessary. He expressed the opinion that a clean field is necessary for success. Cardwell,[6] using the degenerated anterior femoral cutaneous nerve, successfully implanted the graft between the facial musculature and the facial nerve trunk.

Since the majority of peripheral facial lesions are the result of nonspecific toxic paralysis, commonly known as Bell's palsy, several workers have investigated the sequelae of these lesions. Tumarkin [7] in a reasonably large series found that 20 per cent of the patients failed to recover, varying in degrees of residual paralysis. With a careful history, he found that if pain and loss of taste were present, the chances were two to one against complete recovery, but if neither of these was present, the chances were twenty-five to one that recovery would be complete. He expressed the opinion, as did Duel [8] and others, that decompression of the nerve should be performed reasonably early on patients whose recovery is delayed.

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2. Ballance, C., and Duel, A. B.: The Operative Treatment of Facial Palsy, Arch. Otolaryng. **15**:1-70 (Jan.) 1932.

3. Duel, A. B., and Tickle, T. G.: The Surgical Repair of Facial Nerve Paralysis: A Clinical Presentation, Ann. Otol., Rhin. & Laryng. **45**:3-6 (March) 1936.

4. Ballance, C.: A Note on the Operative Treatment of Facial Palsy, Brit. M. J. **1**: 787-788 (April 30) 1932.

5. Martin, R. C.: Recent Experiences with Operation on the Facial Nerve, Arch., Otolaryng. **32**:1071-1075 (Dec.) 1940.

6. Cardwell, E. P.: Direct Implantation of Free Nerve Grafts Between Facial Musculature and Facial Trunk, Arch. Otolaryng. **27**:469-471 (April) 1938.

7. Tumarkin, I. A.: Indications for Surgery in Severe Bell's Palsy, Brit. M. J. **1**:580-581 (March 21) 1936.

8. Duel, A. B.: Surgical Treatment of Facial Palsy: Ballance-Duel Method, Laryngoscope **42**:579-587 (Aug.) 1932.

The distal segment of the severed facial nerve tends to degenerate quickly, and its reaction to the faradic current is a rather important diagnostic sign. Tickle [9] expressed the belief that decompression in conjunction with splitting the nerve sheath is unwarranted in those cases in which muscles do not react to galvanism.

Destructive lesions somewhere along the facial canal are usually associated with mastoiditis. Kettel [10] has presented an exhaustive review of 264 cases with special reference to facial palsy of otitic origin and its treatment both conservative and with active surgical intervention (fig. 2). A tumor or an infection in or

Fig. 2.—The bottom photograph demonstrates a complete simple mastoidectomy on a temporal bone. A probe has been passed into the stylomastoid foramen through the facial canal. Both dissections demonstrate the innocent ease with which the operator or mastoiditis may injure the seventh nerve within the facial canal. For the operation of decompression, grafting or rerouting, it should be remembered that all mastoid cavities differ and that anatomic landmarks should be the only guide.

adjacent to the parotid gland is the cause when severance of the nerve occurs outside of the stylomastoid foramen. In these cases nerve grafting or suturing of the nerve

9. Tickle, T. G.: The After-Care of Surgical Repair of the Facial Nerve, Ann. Otol., Rhin. & Laryng. **45**:7-28 (March) 1936.

10. Kettel, K.: Facial Palsy of Otitic Origin, Arch. Otolaryng. **37**:303-348 (March) 1943.

ends may be used. Bunnell [11] reported success in rerouting the facial nerve outside of the canal and thus gaining length for suturing.

Tarlov and his associates [12] have demonstrated experimentally the value of autologous plasma clot suture of peripheral nerves in instances in which the stumps may be easily approximated without too much tension. When a moderate degree of tension is present, the method still may be used in conjunction with very fine tantalum wire tension sutures. They have further devised a tubular mold which may be utilized for the formation of cable grafts from single strands of nerve glued together with clotted plasma. These methods are applicable to repair of the seventh nerve within the canal.

Unfortunately, all cases are not suitable for a nerve graft operation: Too great a portion of the nerve may be destroyed; the lesion may be of long standing with associated muscular atrophy; it may be one that has not responded to nerve grafting. In these and similar cases, reconstructive surgery may be utilized in order to allow the muscles on the affected side some fascial support on which to brace themselves.

In an excellent review Cleveland [13] related the various methods of plastic repair, and it is my opinion that a combination of these procedures should be employed. Sheehan [14] has used a modification of the method, originally employed by Lexer, in which strips of temporal muscle are taken from their insertion and carried around the orbicularis oris and orbicularis oculi muscles and to the frontalis muscle. He spoke of it as a muscle-nerve graft operation and agreed with Rosenthal that the nerves of the implanted muscles enter those of the affected ones so that the latter are reenervated, and thus the muscles normally supplied by fibers from the facial nerve now receive fibers from the trigeminal nerve. In order to carry the strips of muscle down to the orbicularis oris muscle, Sheehan grooves the zygoma, thus providing a shorter pathway.

For many years Blair [15] has used fascia lata transplants. It has been his studied opinion that whenever damage to the facial nerve has been present long enough to allow sufficient muscle weakness or atrophy eventual nerve grafting may be impotent. Gillies,[16] too, has been an advocate of fascial support either alone, when there is no response to galvanism, or in conjunction with nerve graft when the integrity of the nerve is proved. By turning a flap of the temporal muscle downward and attaching it to fascial slings, the latter having been enveloped around the orbicularis oris muscle, according to Gillies, the trigeminal nerve is brought into greater play. Brown [17] has used fascia lata, carrying it from the temporal region in a loop around the upper lip, extending to the edge of the opposite philtrum, then back again. The two ends are now enveloped in the interstices of the temporal muscle. A similar procedure is carried out on the lower lip.

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11. Bunnell, S.: Surgical Repair of the Facial Nerve, Arch. Otolaryng. **25**:235-259 (March) 1937.

12. Tarlov, I. M., and Benjamin, B.: Plasma Clot and Silk Suture of Nerves, Surg., Gynec. & Obst. **76**:366-374 (March) 1943. Tarlov, I. M.; Denslow, C.; Swarz, S., and Pineles, D.: Plasma Clot Suture of Nerves, Arch. Surg. **47**:44-58 (July) 1943.

13. Cleveland, D.: The Treatment of Facial Paralysis, Internat. Abstr. Surg. **69**:545-555, 1939; in Surg., Gynec. & Obst., July 1939.

14. Sheehan, J. E.: The Muscle-Nerve Graft, S. Clin. North America **15**:471-482 (April) 1935.

15. Blair, V. P.: Further Observations upon the Compensatory Use of Live Tendon Strips for Facial Paralysis, Ann. Surg. **92**:694-703 (Oct.) 1930.

16. Gillies, H.: Experiences with Fascia Lata Grafts in the Operative Treatment of Facial Paralysis, J. Laryng., & Otol. **49**:743-756 (Nov.) 1934.

17. Brown, J. B.: The Utilization of the Temporal Muscle and Fascia in Facial Paralysis, Ann. Surg. **109**:1016-1023 (June) 1939.

Other workers have used these methods or modifications. Regardless of which of the methods is employed, a study of the case on hand with an evaluation of the applicable procedure is most important. If necessity should demand, both nerve graft and reconstructive surgery should be used in combination, or if nerve grafting is impossible, fascial transplant, muscle transplant and excision of the excess skin may be utilized singly or in combination.

METHOD OF SURGICAL TREATMENT

With the patient under preoperative preparation and anesthesia induced with solution of tribromoethanol U. S. P., the area of the face to be excised is marked off with a 3 per cent gentian violet solution. A 2 per cent solution of procaine hydrochloride with solution of epinephrine hydrochloride added (8 drops to an ounce [0.01 cc. to a cubic centimeter]) is injected along the fascial planes of the face

Fig. 3.—*A,* diagrammatic picture of the fascial strips running in loops to the opposite side of the face on both the upper and the lower jaw. The ends of the fascial strips are woven into the temporal muscle to afford vicarious movements to the paralyzed side.

B, The Blair needle in place demonstrating its position from the temporal region down through a nick in the skin on the opposite side of the face allowing the fascia to be drawn back to position.

as an aid to dissection and as a hemostatic. An incision is carried from the temporal region downward along the anterior aspect of the auricle, around the lobule of the ear, then upward on the posterior aspect of the auricle and finally across to the hairline. Through this incision, the skin over the face is thoroughly undermined and bleeding controlled.

The thigh, having previously been prepared, is now exposed for incision and the gaining of fascia for transplant. Though a fascia stripper may be used, when a large rectangle of fascia is needed, as in these cases, I am not reluctant to make a long incision, remove the fascia and then carefully suture the wound. By doing this

I gain the necessary fascia and avoid herniation of muscle, and pay for it with a long scar; but the operation depends on acquiring sufficient fascia, and I have found that exposure is often necessary.

The fascia is spread on a pithwood board, and strips 1 cm. in width are cut. If an extra long piece is needed, two strips may be spliced. The strips are placed in warm saline sponges and made ready beside the surgeon's assistant.

Beginning at the temporal region, the Blair needle (fig. 3) is encased beneath the superficial portion of the deep fascia and run in an arc downward to the upper lip, piercing the skin through an incision nicked just lateral to the farthest edge of the philtrum at a point immediately below the columella. The assistant then feeds one end of a fascial strip to the harpoon hook of the Blair needle, and the surgeon retracts the latter, bringing the fascia out at the temporal region. The Blair needle is then entered through a nick incision in the skin of the lip a half inch below the first, and the fascia is woven through to come out at this lower point. The needle is again passed down from the temporal region, coming out through the lower incision on the lip, the fascia is grasped in its hook and retracted.

Fig. 4.—Area of full thickness skin removed to allow for an adjustment of the affected side of the face in conjunction with fascia transplant. The complete operation was thus accomplished in one stage. (The patient is on the operating table under anesthesia induced with solution of tribromoethanol U. S. P.)

The lower end of the fascia is woven into the interstices of the temporal muscle, then securely tied to the upper end and locked with a silk stitch (fig. 3*A*).

A similar procedure is carried out on the lower lip, the fascial sling passing from the temporal region to the upper aspect of the lower lip, down toward the symphysis of the mandible, then back to the temporal region. If necessary a shorter sling may be passed to the corner of the mouth on the affected side. In all of these procedures the surgeon must be careful to overcorrect the deformity.

The section of skin previously outlined on the face for excision is now removed (fig. 4). All bleeding or oozing has been meticulously controlled. Sulfanilamide crystals are sprinkled within the whole wound just before closure. The face flap is supported with a purse string and approximated with a subcuticular silk suture, and the edges are sewn with fine black silk.

The whole area is dressed virtually like a skin graft: First petrolatum-impregnated gauze is applied; then carefully cut gauze flats overlaid with mechanic's waste and marine sponge are laid in place, with a stockinette head bandage being used for pressure.

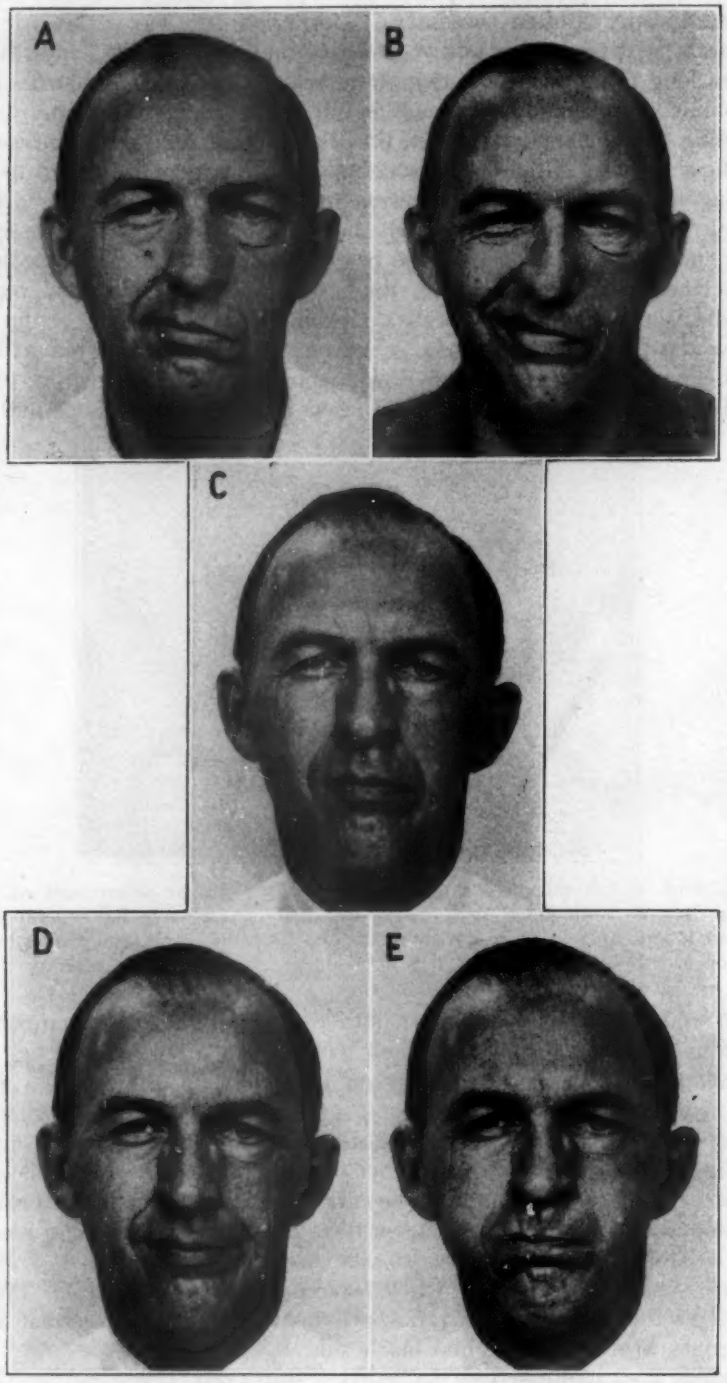

Figure 5

(See legend on opposite page)

When paralysis has affected the eyelids, several plastic procedures may be employed. Often, with time, associated movements will spontaneously effect some mechanical improvement. Flaps of temporal muscle may be brought down to encircle the eye; one within the upper eyelid reaching to the internal canthus, another within the lower eyelid. A fascia sling may be similarly used attaching it to the temporal muscle. The resulting excess tissue on the lower lid is disfiguring and, as expressed by Halle,[18] a required ellipse may be removed with the tension at the external canthus.

POSTOPERATIVE CARE

The patient must be quiet, and the diet is liquid for ten days. The dressing is kept snug; it is removed in a week, and adhesive strapping is applied. Normal movements are started slowly in three weeks. As emphasized by both Brown and Straatsma,[19] if the patient complains of overcorrection at this time, the surgeon suspects that his eventual result will be satisfactory.

COURSE AFTER SURGICAL TREATMENT

In any case of long standing, the muscles supplied by the seventh nerve do not return to function. In cases in which repair has been done with a fascial transplant, the function of the face is a vicarious one, its burden on the shoulders of the trigeminal nerve. It becomes necessary for the patient to reeducate his facial movements and to think in terms of the temporal muscles, for it is from here that he gains expression. It demands exercise and thought regularly each day, and when this is carried out, the results are gratifying (fig. 5). Sudden emotion and any deviation from the new habit formation will allow the nonaffected side to assume its authority.

CONCLUSION

The technic of reconstruction for facial paralysis which has been presented combines a fascial transplant with the temporal muscle in conjunction with an adjustment of the relaxed tissues of the face.

The extent of facial paralysis must be evaluated so that the most applicable method of repair may be used.

6777 Hollywood Boulevard.

18. Halle, M.: The Occurrence of Facial Paralysis and Methods for Its Correction, Laryngoscope **48**:225-235 (April) 1938.

19. Straatsma, C. R.: Plastic Reconstruction in Facial Palsy, Laryngoscope **49**:482-483 (June) 1939.

EXPLANATION OF FIGURE 5

A and *B*, facial paralysis following poliomyelitis. The paralysis had been present since the age of 4, making nerve repair impossible. Note the asymmetry of the face, the obliteration of the nasolabial line on the affected side, the atrophy of the musculature, and the ptosis of the lower lid.

Smiling caused the face to be pulled over to the nonaffected side, owing to overaction of the muscles. The nose too is pulled over. He could neither whistle nor blow out his cheeks.

C, *D*, and *E*, result two months after treatment by fascia transplant. A rectangle of fascia 42 cm. by 8 cm. was taken from the thigh and tailored into strips, and the strips were used as slings on the paralyzed side of the face.

The symmetry of the face has been restored, the patient is able to blow out his cheeks and whistle and the ptosis of the left lower lid has been corrected. Reeducation allows emotional expression.

A CORRELATION BETWEEN VESTIBULAR FUNCTION AND HEARING IN THE PROFOUNDLY DEAF CHILD

MARY FRANCES VASTINE, M.D.
PHILADELPHIA

Since no correlation between vestibular function and hearing in a series of very deaf children has been made, it seemed that such a study was justified. Then, too, certain questions were of tantalizing interest. For example, What number, if any, of profoundly deaf children exhibit normal vestibular function? Is the correlation between vestibular function and hearing such that a certain type of hearing curve can be foretold from a given result on test of vestibular function? Can any conclusions be drawn relative to vestibular function when the etiologic factor which has produced the deafness is known?

As Hughson, Ciocco and Palmer [1] pointed out, the past decade has happily seen a marked increase in the understanding of the deafened person's problems. As a result, otologists are beginning to realize that their total contribution to the prevention of deafness has not been great. There has been no appreciable decrease in the proportion of the population with impaired hearing as a result of their efforts in the past. It seemed, therefore, that the questions postulated merited investigation, for it was felt that if any conclusions could be drawn concerning the relationship between the vestibular and the cochlear apparatus, a real addition to the study of the problem of deafness might be made.

Goldstein [2] wrote, "If, in a deaf child, no response to any other functional test can be obtained and a nystagmus reaction still be present, there is the thought that even though the acoustic labyrinth does not respond to functional test, the histological elements that comprise it may not be entirely beyond salvage." Wirth [3] studied a series of deaf children and concluded that it is not unusual to find normally active static labyrinth in the deaf child. He expressed the belief that the case is probably one of congenital deafness if normally active labyrinths are accompanied by residual hearing which is equal in the two ears.

PROCEDURE

The status of the semicircular canals in 408 ears of 208 pupils (ranging in age from 14 to 19 years) at the Pennsylvania School for the Deaf was determined. Then the degree of activity remaining in this part of the inner ear was correlated with the residual cochlear activity by comparing the results of the vestibular tests with audiometric readings on the same group.

The Bárány caloric or mass irrigation method was used in examining the vestibular apparatus. As recommended by Jones and Fisher,[4] the time from the beginning of douching

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From the Pennsylvania School for the Deaf, Mt. Airy, Philadelphia.

Read before the Section on Otolaryngology of the College of Physicians of Philadelphia and the Philadelphia Laryngological Society, April 21, 1943.

Thesis submitted to the Faculty of the Graduate School of Medicine of the University of Pennsylvania toward the requirement for the degree of Doctor of Medical Science (D.Sc.Med.) for graduate work in otolaryngology.

1. Hughson, W.; Ciocco, A., and Palmer, C.: Studies of Pupils of the Pennsylvania School for the Deaf: I. Auditory Acuity, Arch. Otolaryng. **29**:403-416 (March) 1939.

2. Goldstein, M. A.: Problems of the Deaf, St. Louis, Laryngoscope Press, 1933.

3. Wirth, E.: Diagnosis of Hereditary Deafness According to Symmetrical Distribution of Residual Hearing Capacity and Vestibular Excitability, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **141**:212-216, 1936.

4. Jones, I. H., and Fisher, L.: Equilibrium and Vertigo, Philadelphia, J. B. Lippincott Company, 1918.

with tap water at 68 F. until the time when nystagmus was produced was noted. The type and the amplitude of the nystagmus were recorded together with the presence or the absence of a shock reaction as exemplified by pallor, sweating, nausea or vomiting. In testing the vertical canals, the head was held 30 degrees forward, and immediately after their reaction was seen, the head was turned backward 60 degrees to elicit a reaction from the horizontal canal. The test was done only on those ears in which the tympanic membrane was intact.

In evaluating the degree of activity of the semicircular canals, the reaction was considered "normal" if nystagmus was produced in fifty-five seconds or less of douching. Activity was considered "moderately hypoactive" if the response was elicited from fifty-five seconds to two minutes after douching was begun. If the latent period was longer than two minutes, activity was put down as "markedly hypoactive." If no nystagmus was produced after douching for four minutes, the labyrinth was considered "inactive."

Ninety-eight ears (37 bilateral and 24 unilateral) responded normally to the caloric test; 116 ears (32 bilateral and 52 unilateral) exhibited moderately hypoactive reactions; 107 ears (29 bilateral and 49 unilateral) were markedly hypoactive; 76 ears (28 bilateral and 20 unilateral) gave no response to the caloric test; 11 ears reacted as markedly hypoactive to the test from one set of canals but gave no response from the other set of canals. In other words, 24.0 per cent of the ears in the series under discussion had normally active labyrinths; 28.4 per cent had moderately hypoactive labyrinths; in 26.2 per cent the labyrinths were

TABLE 1.—*Audiograms on the Ninety-Eight Ears with Normally Active Labyrinths*

	Number of Ears Perceiving the Given Auditory Frequency						
Decibels	128	256	512	1024	2048	4096	8192
10	..	2	..	..	..	..	..
15	2	2	..	..	..	..	..
20	6	1	..	..	..	..	..
25	2	3	2	..	..	..	..
30	6	4	1	1	..	..	1
35	8	7	3	1	3	..	5
40	3	7	3	1	..	4	..
45	5	4	5	1	..	1	..
50	5	4	4	4	..	1	1
55	9	8	6	4	1	3	2
60	11	10	6	8	3	3	2
65	10	16	6	3	6	5	6
70	11	10	7	6	7	6	5
75	4	6	7	6	6	7	7
80	..	5	9	10	8	4	4
85	..	3	12	6	4	5	..
90	..	5	6	7	9	1	..
95	..	..	7	5	5	..	..
100	..	..	7	16	5	..	..
No response	16	1	7	19	41	58	65

markedly hypoactive; 18.6 per cent had inert labyrinths, and in 2.7 per cent the labyrinths were in part markedly hypoactive and in part inert. It is seen from these figures that there is some remaining vestibular viability in 81 per cent of the ears. This is an encouraging finding, especially to the one who wishes to consider the cochlea a potentially viable organ as long as there is any remaining susceptibility to stimulation in the semicircular canals.

AUDIOMETRIC FINDINGS AND CORRELATION

The hearing in the 408 ears was examined for air conduction by means of a Sonotone model 1 audiometer. One pupil in the group was unable to perceive any frequency in either ear. Thirteen pupils were unable to perceive any frequency in one ear but responded to at least one in the opposite ear. Thus, 99.5 per cent could perceive at least one frequency in one or the other ear, and 93.2 per cent perceived at least one in both ears. These figures are higher than those obtained by Hughson, Ciocco and Palmer [1] in their study of auditory acuity. The apparent discrepancy might be accounted for by the fact that, as well as being a smaller group, this was an older age group and one in which young persons with perforate drums were excluded.

In the correlation between vestibular and cochlear findings, the ears were grouped according to their labyrinthine activity and then the audiograms of the ears included in each group were analyzed. Table 1 includes all the ears with

normally active labyrinths, and under the different auditory frequencies are listed the number of ears which responded to a given cycle at a given intensity. Table 2 includes the ears with moderately hypoactive labyrinths alined according to audio-

TABLE 2.—*Audiograms on the One Hundred and Sixteen Ears with Moderately Hypoactive Labyrinths*

	Number of Ears Perceiving the Given Auditory Frequency						
Decibels	128	256	512	1024	2048	4096	8192
15	2	..	..	..	..	..	..
25	2	1	..	..	..	..	..
30	2	3	1	..	..	..	..
35	5	2	..	..	..	..	..
40	3	2	..	..	..	..	..
45	6	4	1	1	2	..	..
50	6	6	4	1	..	1	..
55	6	8	3	..	2	..	..
60	14	12	4	1	2	1	..
65	14	21	5	5	1	4	2
70	14	20	6	6	4	..	5
75	16	13	10	5	2	1	3
80	..	11	15	5	4	9	6
85	..	6	24	5	5	6	..
90	..	2	12	7	7	6	..
95	..	..	12	17	5	..	..
100	..	..	11	27	8	..	..
No response	26	5	8	36	74	88	100

TABLE 3.—*Audiograms on the One Hundred and Seven Ears with Markedly Hypoactive Labyrinths*

	Number of Ears Perceiving the Given Auditory Frequency						
Decibels	128	256	512	1024	2048	4096	8192
15	..	1	..	..	..	..	..
25	2	1	..	..	..	..	..
30	2	..	..	..	..	..	..
35	1	1	..	..	..	1	..
40	3	3	3	..	2	..	..
45	2	3	..	2	..	1	2
50	7	3	4	..	..	..	..
55	10	6	4	4	..	..	..
60	7	10	2	1	1	2	..
65	16	13	2	1	1	1	1
70	16	16	2	3	3	..	1
75	13	14	4	..	1	2	2
80	..	19	13	3	6	3	..
85	..	9	13	6	1	2	1
90	..	2	15	4	3	1	..
95	..	..	9	8	3	..	..
100	..	..	15	26	7	1	..
No response	28	6	21	49	79	93	100

TABLE 4.—*Audiograms on the Seventy-Six Ears with Inactive Labyrinths*

	Number of Ears Perceiving the Given Auditory Frequency						
Decibels	128	256	512	1024	2048	4096	8192
45	..	1	..	..	..	..	..
50	3	2	..	..	..	..	..
55	4	2	..	..	..	..	..
60	17	6	1	1	..	..	..
65	12	11	1	..	..	..	..
70	9	6	4	1	2	1	..
75	7	12	1	2	1	..	..
80	..	12	2	1	1	1	..
85	..	5	1	..	1	1	..
90	90	4	3	1	..	1	..
95	..	..	4	2	3	..	..
100	..	..	13	5	2	..	..
No response	24	15	46	63	66	72	76

metric reaction. In table 3 the ears with markedly hypoactive labyrinths are tabulated according to audiometric response, and table 4 includes the ears with inactive labyrinths regimented in the same fashion.

In further preparation of this material for statistical analysis, a method used by Hughson and co-workers [1] was adopted. As these authors have explained, the arithmetical mean cannot be employed as an efficient statistical constant to express the "average" threshold of hearing for any given frequency. Since all these children had marked hearing impairment, their auditory thresholds were concentrated in the high intensity regions, and for some tones the majority of the children perceived no auditory stimulus even at the maximum intensity possible to the audiometer. Therefore the statistical constant used to express the average is the "median" which expresses the auditory acuity of the 50 per cent of the ears with the best hearing. If, as seen in table 5, the median is indicated with an asterisk (not heard), it means that less than 50 per cent of the ears were able to perceive the tone at the greatest intensity of the audiometer.

TABLE 5.—*Median Auditory Thresholds of Three Hundred and Ninety-Seven Ears*

	Air Conduction, Db			
Auditory Frequency Cycles	98 Ears with Normally Active Labyrinths	116 Ears with Moderately Hypoactive Labyrinths	107 Ears with Markedly Hypoactive Labyrinths	76 Ears with Inactive Labyrinths
128	39.4	51.1	55.5	60.8
256	41.1	55.3	58.6	65.8
512	56.1	71.4	74.2	*
1024	66.4	83.5	87.3	*
2048	74.3	*	*	*
4096	*	*	*	*
8192	*	*	*	*

TABLE 6.—*Percentage of Ears in Each Group Reacting to a Given Frequency*

	Percentage of Ears Perceiving the Given Auditory Frequency						
Type of Ear	128	256	512	1024	2048	4096	8192
Ears with normally active labyrinths (98)	83.7	99.0	92.8	80.6	58.2	40.8	33.7
Ears with moderately hypoactive labyrinths (116)	77.6	95.7	93.1	69.0	36.2	24.1	13.8
Ears with markedly hypoactive labyyrinths (107)	73.8	94.4	80.4	54.2	26.2	13.1	6.5
Ears with inactive labyrinths (76)	68.4	80.2	39.4	17.1	13.2	5.3	0.0

Table 5, the data for which were obtained from tables 1, 2, 3 and 4, and the chart show the auditory thresholds for the ears grouped according to vestibular activity. Table 6 presents the material from the standpoint of percentage.

The ears which had normally responsive semicircular canals (approximately one fourth of the series) showed a median threshold for each auditory frequency which was at a lower intensity level than that noted for the ears with hypoactive static labyrinths. Over 50 per cent of these ears with normal labyrinths reacted to the first five auditory frequencies. However, 59 per cent did not perceive 4096 cycles, and 66 per cent did not perceive 8192 cycles.

The ears in the hypoactive labyrinth groups together constituted over half the series. The ears with moderately hypoactive labyrinths had cochleas which showed a lower median auditory threshold than did those of the group with markedly hypoactive labyrinths. The ears with the more marked vestibular impairment had a threshold for the frequency of 128 cycles which was 4.4 decibels higher than that for the ears with vestibular involvement which was less marked; for 256 cycles the threshold for the more involved ears was 3.3 decibels higher; for 512 the difference

was 2.8 decibels, and for 1024 cycles, 3.8 decibels. The majority of ears in both hypoactive labyrinth groups responded to only the first four auditory frequencies.

The ears with inactive labyrinths (less than one fifth of those making up the total number) showed the highest median auditory thresholds and this only for the first two auditory frequencies, as over 50 per cent did not perceive the last five audiometric frequencies.

The 11 ears with vestibular reactions which were mixed in character (with one or more canals inert and one or more showing some residual activity) were not included in the tables. However, the median auditory threshold in these ears tallied with that exhibited by the ears with inert labyrinths, over half the ears perceiving the first two frequencies with less than half responding to the last four frequencies.

Reviewing the data just presented, one observes that as vestibular function becomes progressively less, the median auditory threshold becomes progressively higher. This would make it seem that there is a definite correlation between loss in vestibular function and hearing impairment. In general, it may be said that as goes the semicircular canals so goes the cochlea. Thus the median threshold for the frequency of 128 cycles in the ears with normal vestibular function is 39.4 decibels, compared with 51.1 decibels for the ears with moderately hypoactive vestibular function, 55.5 decibels for those with markedly hypoactive reaction and 60.8 decibels for those with inactive semicircular canals. Considering now the highest auditory frequency from a somewhat different point of view, one observes that 66.3 per cent of the ears with normally functioning labyrinths do not perceive the frequency of 8192 cycles; 86.2 per cent of the ears with moderately hypoactive labyrinths do not perceive this frequency; 93.5 per cent of those with markedly hypoactive labyrinths do not hear it, and 100 per cent of the ears with inactive labyrinths do not react to the frequency of 8192 cycles. The percentage of ears in successive groups responding to a given auditory frequency is seen to become progressively smaller (with one exception as shown in table 6) as one proceeds from the ears with normally active labyrinths through those with inactive labyrinths.

Seventy-five per cent of the ears with inert semicircular canals responded to two or more audiometric frequencies, and 34 per cent responded to three or more frequencies. At least 80 per cent of the ears which responded to the three or more frequencies did so at an intensity of 60 decibels or greater. The audiometric records on 2 pupils with bilateral inactivity of the semicircular canals were unusual in that there was no response to any frequency on the part of one ear while the other ear reacted to all the frequencies save that of 8192 cycles. In both instances the cause of deafness was listed as meningitis. These findings support the claim that this disease may entirely destroy the static labyrinth while leaving the acoustic labyrinth more or less intact.

CORRELATION BETWEEN CAUSE OF DEAFNESS AND FINDINGS

It was felt that some correlation between the stated cause of deafness and the vestibular and the cochlear function might prove of interest. Table 7 shows the relation between the vestibular function and the stated cause of deafness. Etiologically, the description "born deaf" was listed for 114 young persons, or 55 per cent of the number studied. "Cause unknown" was noted for 14, while a known cause acquired after birth was thought to be the factor contributing to the aural involvement in 80 young persons. It seems likely that the "cause unknown" group had a postnatal etiologic factor since the so-called mute child or the one who never hears intelligible speech and therefore cannot utter it is more apt to be classified as "born deaf." Therefore, if this group is added to the group with definitely acquired

causes, 93, or 45 per cent, of the young persons are included in the group who presumably became deaf sometimes after birth. With respect to these 93 young persons: The deafness in 16 (or 17 per cent) was said to have been caused by meningitis and that in another 16 (or 17 per cent) was said to have been due to measles. The deafness in 11 (or 12 per cent) was ascribed to an "injury" and that in 8 (9 per cent) to otitis media. Syphilis was the stated cause in 3 persons and pneumonia in 3. With less frequency, scarlet fever, influenza, pertussis, mumps, anterior poliomyelitis and "convulsions" were noted.

Over half (53 per cent of 40) of the young persons having both labyrinths normally active were in the "born deaf" group, while 63 per cent of those with labyrinths hypoactive to various degrees were included in this category. Of the 28 young persons with both labyrinths inert, only 5 were contained in the "born deaf" class. On the other hand, 12 of the number in whom meningitis was given

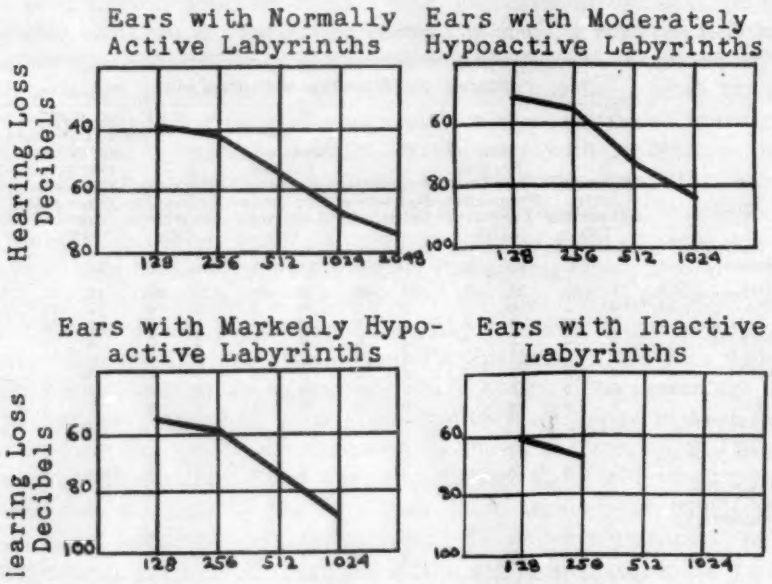
TABLE 7.—*Correlation of Cause of Deafness with Activity in the Static Labyrinth*

Stated Cause of Deafness	Number and Percentage of Children with: Normally Active Labyrinths (40)		One Normal and One Hypoactive Labyrinth (21)		Moderately Hypoactive Labyrinths (34)		One Moderately and One Markedly Hypoactive Labyrinth (26)		Markedly Hypoactive Labyrinths (30)		One Hypoactive Labyrinth and at Least One Set of Canals on Other Side Inactive (28)		Inactive Labyrinths (28)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Born deaf (114)	21	53	15	71	21	62	16	62	19	63	17	61	5	18
Meningitis (16)	0	0	0	0	0	0	0	0	0	0	4	14	12	43
Measles (16)	5	13	1	5	3	9	2	8	2	7	1	4	2	7
Cause unknown (14)	6	15	0	0	2	6	2	8	1	3	2	7	1	4
Injury (11)	2	5	1	5	1	3	2	8	2	7	0	0	3	11
Otitis media (8)	2	5	0	0	3	9	2	8	0	0	0	0	1	4
Syphilis (3)	0	0	0	0	0	0	0	0	0	0	2	7	1	4
Pneumonia (3)	0	0	0	0	0	0	0	0	1	3	1	4	1	4
Scarlet fever, influenza, tonsillitis, pertussis, coryza, rickets (2 each) (12)	3	8	3	14	2	6	0	0	3	10	0	0	1	4
Mumps, poliomyelitis, "convulsions," "paralysis," mastoidectomy (1 each) (5)	0	0	1	5	0	0	1	4	2	7	0	0	1	4
"Illness" (5)	1	3	0	0	2	6	1	4	0	0	1	4	0	0

as the cause of deafness were in the group with inert labyrinths. This is a significant finding when it is noted that there were only 16 subjects in whom meningitis was given as the cause of deafness. Therefore, the 12 with inert labyrinths represented 75 per cent of the total number of young persons deafened by meningitis whereas the 5 "born deaf" pupils made up only 4.4 per cent of the total number (114) "born deaf." Moreover, the other 4 (25 per cent) young persons who had undergone meningitis were included in the group of pupils in whom there was present at least one set of inert semicircular canals. These findings would certainly seem to substantiate the fact that meningitis has its devastating effect primarily on the static labyrinth. Just under the 16 subjects whose deafness was ascribed to meningitis in table 7 are listed the 16 whose deafness was due to measles. The difference in distribution in these two series of 16 is striking. Whereas the meningitic ones are concentrated at the right of the table in the inactive labyrinth columns, the subjects with measles as the cause are distributed fairly evenly throughout the different groups of vestibular activity (except for a slight preponderance in the normally active group).

As for the relation between stated cause of deafness and cochlear function, of the 30 young persons with 38 ears which responded to only one audiometric

frequency or none and which therefore may be considered as having inert cochleas, 10 were said to have been "born deaf" while 20 were said to have an acquired type of deafness. These figures are the more significant since in the whole group studied those who were said to have been born deaf number 21 more than do those in whom the deafness was said to have been acquired. The figures indicate that the cause of deafness which is acquired is much more apt to produce complete degeneration of the organ of hearing than is the "born deaf" causation. Included among the 20 young persons whose deafness was acquired were 4 who had had measles and 4 who had had meningitis. Though the figures are small, they imply that meningitis is no more prone to cause complete devitalization of the cochlea than is any other acquired infection although, as has been shown, this disease causes devitalization of the vestibular organ in every instance. It may now be noted that one exception to the generalization which has been made that "as goes the static



Audiograms for the data presented in table 5: Median auditory thresholds for air conduction of ears with different degrees of reactivity in their labyrinths.

labyrinth so goes the acoustic labyrinth" exists in those cases in which aural involvement is due to meningitis.

Considering again the 38 ears with presumably inert cochleas, a correlation between the cause of deafness and the vestibular and the cochlear function was made at one and the same time. In the group "born deaf," 3 of the 114 pupils (2.6 per cent) had at least one normal labyrinth with an inert cochlea; 2 of the number (1.8 per cent) had at least one hypoactive labyrinth with an inert cochlea: 5 of the 114 (4.4 per cent) had at least one inert labyrinth with an inert cochlea. In the group with acquired deafness, not one of the 93 had a normal labyrinth with an inert cochlea; 10 of the 93 (10.9 per cent) had at least one hypoactive labyrinth with an inert cochlea, and 10 others of the same 93 (10.9 per cent) had at least one inert labyrinth with an inert cochlea. These findings support what is already known concerning the genesis of congenital deafness; i. e., if the cause of deafness in the "born deaf" ear produces a devitalized cochlea, it may

in a certain percentage of cases spare the labyrinth entirely. Thus, Howe and Guild [5] remarked that the histopathologic condition of the inner ears of certain incompletely albinotic animals is already well recognized. In these animals, which fail to react to sound stimuli although gait and equilibrium appear normal, there is practically complete absence of the organ of Corti while the semicircular canals are normal.

On the other hand, if the cause which has been acquired devitalizes the cochlea, it never entirely spares the labyrinth. If measles infection has entirely destroyed the cochlea, the labyrinth is apt to be only partially destroyed, but if the cochlea has become inert as the result of meningitis, a labyrinth inert in its entirety will always accompany it.

SUMMARY

A correlation of the results of vestibular tests and audiometric studies done on 408 ears in 208 pupils at the Pennsylvania School for the Deaf yields the following observations:

1. Complete loss of vestibular function is a comparatively rare finding in profoundly deaf young persons, some degree of vestibular activity being noted in 81 per cent of these ears. Function was normal in 24 per cent and subnormal in 57 per cent.

2. In general decreases in activity in the static labyrinth may be said to parallel decrease in activity in the acoustic labyrinth. An apparent exception to this statement exists when the involvement is due to meningitis.

3. Corresponding to the vestibular activity of an ear, a "type audiogram" can be drawn up. For example, over 50 per cent of the ears with normally functioning static labyrinths responded to the first five audiometric frequencies but not to the two highest ones; more than half the ears with hypofunctioning labyrinths reacted to the first four frequencies and not to the last three; the majority of the ears with inert static labyrinths gave a response to the first two audiometric frequencies but not to the last five.

4. It seems that if the deafness is of the congenital type, involvement in neither the static nor the acoustic labyrinths is prone to be as marked as in the case in which the deafness is due to some etiologic factor acquired after birth. The static labyrinths of ears in which deafness has been caused by meningitis are always partially or completely inert. At least this was true in the 16 young persons of this series whose deafness was due to meningitis.

6809 Emlen Street.

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APPLICATION OF THE HEMILARYNGECTOMY TECHNIC IN LARYNGECTOMY

MERVIN C. MYERSON, M.D.
NEW YORK

A large experience with hemilaryngectomy performed by means of the laryngofissure exposure impressed me with the relatively little reaction and the rapid convalescence which usually follow this procedure. It occurred to me, therefore, that total laryngectomy, being little more than bilateral hemilaryngectomy with the added factors of a tracheal cannula, a nasal feeding tube and the necessity of repairing a pharyngeal defect, might be performed by this technic.

Removal of the larynx in two halves appealed to me because it seemed easier to perform and held promise of less trauma, less local reaction and the conservation of a greater amount of healthy mucous membrane for purposes of repair. The more mucous membrane saved, the greater would be the mobility of the anterior wall segment, hence a smaller defect, insuring easier closure and the prospect of primary union.

In addition to resection of the larynx in two parts, it was decided to substitute a low tracheotomy opening for the tracheal stoma. Ordinarily the tracheal stoma lies in the path of the wound secretions, saliva and mucus, requiring a properly wrapped tracheal cannula to cork the trachea against seepage from above. If a tracheotomy opening is to take the place of the stoma, it must be sealed over, in order to prevent the wound from draining directly into the trachea.

As a result of the foregoing considerations, the following operation has been evolved:

The tissues in the front of the neck from the hyoid region down to the episternal notch are infiltrated with a solution of procaine hydrochloride, as are also the tissues immediately surrounding the thyroid cartilages and the upper part of the trachea. The thyrohyoid membrane just medial to the greater cornu of the thyroid cartilage on each side is injected, so as to anesthetize the superior laryngeal nerve. Solution of procaine hydrochloride may be used, with or without solution of tribromoethanol, by rectum.

A midline incision is made from the region of the hyoid bone ot the episternal notch.

Dissection is carried through the superficial and the deep fascia down to the trachea and the thyroid cartilage. The muscles originating from the upper end of the sternum are retracted, the thyroid gland is pushed out of the way, if necessary, and an elliptic segment is removed from the anterior tracheal wall in the region of the sixth or the seventh ring. A no. 8 tracheal tube is introduced. Performing the tracheotomy a week or more before the laryngectomy has certain advantages: (1) The tracheobronchial reaction at the time of the main operation is eliminated; (2) the patient will have become accustomed to his tube.

The thyroid cartilage is now exposed. A midline incision is made through the perichondrium from the thyroid notch to the cricothyroid membrane. The perichondrium of the left ala is elevated as far as the upper, lower and posterior borders. A retractor is placed beneath the perichondrium, so that all structures from the cartilage to the skin are within its grasp.

The blood vessels entering and leaving the cricothyroid membrane on each side are clamped and divided. The thyrohyoid and sternothyroid muscles are clamped and severed close to their attachment to the oblique line of the thyroid cartilage. The thyroid cartilage is cut through in its midline by means of a rotary saw powered by a small hand motor. The anterior commissure is then cut through. By means of a double-pronged, sharp retractor placed at the middle of the posterior border of the thyroid cartilage, the ala is pulled forward. This brings the greater cornu into the field. It is severed close to the cartilage, care being taken not to enter the pharynx. The detached structure is left behind.

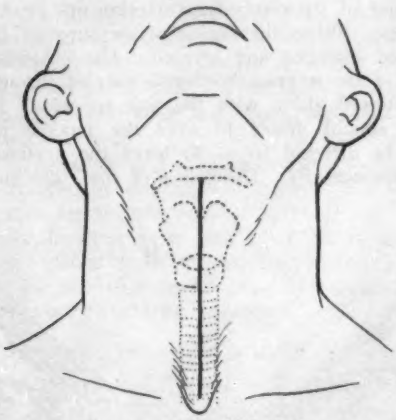

Fig. 1—Line of incision.

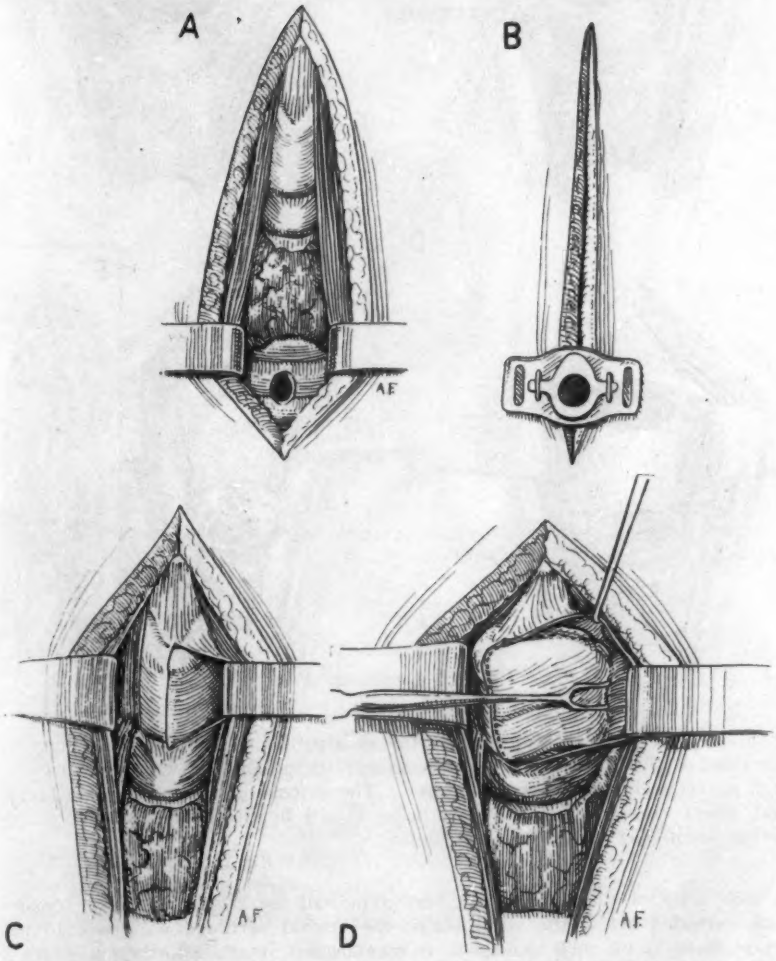

Fig. 2.—*A*, exposure of deep structures of the front of the neck, with the lower part of the trachea opened. *B*, tracheotomy tube in place. *C*, external perichondrium of the left side of the thyroid cartilage retracted; line of incision through cartilage. *D*, exposure of thyroid ala, with a two-pronged retractor pulling the ala forward. The superior cornu has been severed.

The upper border is freed of its soft tissue attachments by means of an incision which hugs the edge of the cartilage. When the region of the superior laryngeal vessels is reached, these structures are identified, clamped and severed. The posterior and inferior borders are similarly freed. Dissection of the inferior border is carried through the cricoarytenoid joint, so that the arytenoid is removed along with the soft tissues of the larynx and the thyroid cartilage. If the surgeon should desire to save the mucous membrane surrounding the arytenoid, the incision can be directed so as to leave the arytenoid in place. Subsequently the arytenoid is removed submucosally. Dissection of the right side is the same as that just described for the left.

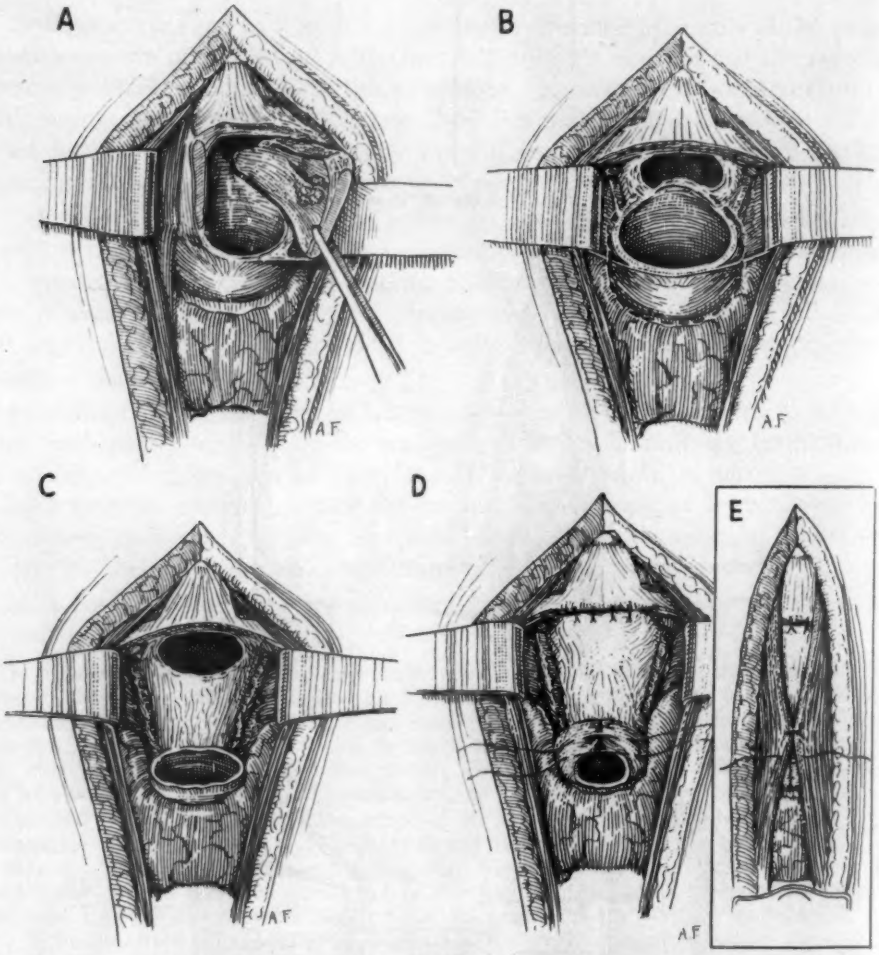

Fig. 3.—*A*, left ala and adjacent soft tissues after being detached. *B*, pharyngeal defect after both sides of the larynx have been removed; the cricoid cartilage remains. *C*, tracheal stoma and pharyngeal defect before closure. The cricoid cartilage has been removed. *D*, pharyngeal defect closed; trachael stoma being closed by inversion sutures. *E*, sternohyoid muscle being sewn over closed tracheal stoma.

After both sides of the larynx have been removed, the cricoid cartilage remains. If the cancer has extended below the vocal cords, the cricoid cartilage will have to be removed. If, however, there is no such extension, it may be left intact, affording a stoma for which a cannula is not required. When retention of the cricoid cartilage is possible, the technic is as usual. The previously inserted tracheotomy tube is removed at the completion of the operation.

When the cricoid cartilage is removed, as it is in most operations, the upper end of the trachea is inverted and sealed. For this purpose the uppermost tracheal ring is removed.

the mucous membrane being left intact. After the open end of the trachea is inverted by interrupted sutures, the sternohyoid muscles are sutured together directly over the stump. if the thyroid gland is in close proximity to the stump it may be used instead of the muscles.

The epiglottis is inspected for possible involvement. If it is at all suspected, it is removed.

The nasal feeding tube is passed down into the lower part of the esophagus before the pharyngeal defect is completely closed.

The pharyngeal defect is closed with two superimposed continuous inversion sutures. The fascia and muscles are overlapped by interrupted sutures. The skin is closed and a thin strip of Penrose drain inserted into the subcutaneous space from the lower end of the wound.

The dressing is essentially the same as for any laryngectomy except that there is more space separating the laryngectomy wound from the tracheal tube. The preliminary placement of the trachea tube eliminates the need for the additional suturing of the tracheal mucosa to the skin and the preparation of these structures for suture.

The indications for this operation can be well defined: It is an ideal procedure for cases in which the cancer is well localized in the region of one or both cords and in which the growth is too extensive for the conservative operation of laryngo-

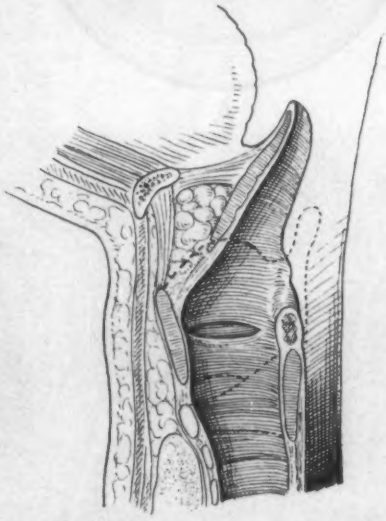

Fig. 4.—Lateral view of the larynx showing the relative position of the thyroid cartilage. The dotted lines above and below indicate the boundaries of location of a carcinoma which can be attacked by operation.

fissure. It can be used for all intrinsic cancers, but its greatest field of application should be that of the less extensive lesions. All lesions within the larynx extending between lines corresponding to the upper and lower borders of the thyroid cartilage can be operated on by this method. See figure 4.

The possible objections and disadvantages are as follows: 1. There is the necessity of cutting through growth in the anterior commissure or a subglottic extension when this exists; however, cutting through cancer in this location is no more dangerous than removing a specimen for biopsy. 2. The placement of a permanent tracheotomy tube eliminates the possibility of a stoma without a tube. This is of no special consequence except in those cases in which the cricoid cartilage is retained, since most require a cannula.

The possible advantages are: 1. It is easier to remove an object from its encasement in halves than as a whole. 2. The operative trauma and the postoperative reaction are reduced, and there is more rapid healing. 3. A greater amount of mucous membrane can be conserved for closing the pharyngeal defect, and there

is a greater expectation of primary union. 4. The operating time is reduced. 5. Postoperative care is simplified. 6. Relatively little reaction follows. 7. Complications are fewer. 8. During the operation the surgeon does not have to worry about possible obstruction or collapse of the tracheal stoma, because of preliminary

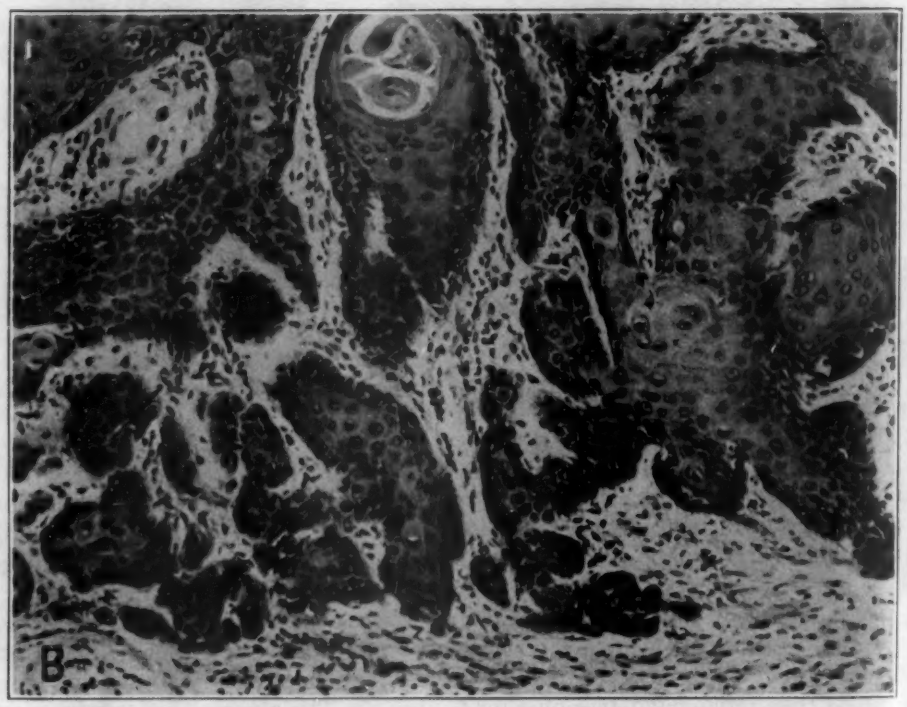

Fig. 5 (case 1).—*A*, extent of carcinoma. *B*, photomicrograph of squamous cell carcinoma; × 350.

tracheotomy. 9. The blood vessels are more easily exposed. There is negligible loss of blood.

Two patients have been operated on by this technic. In both cases the operation consumed relatively little time. The lack of untoward reaction of both patients

was impressive. In both the upper tracheal orifice remained completely and permanently sealed, so that there was no concern about seepage into the lower air passages.

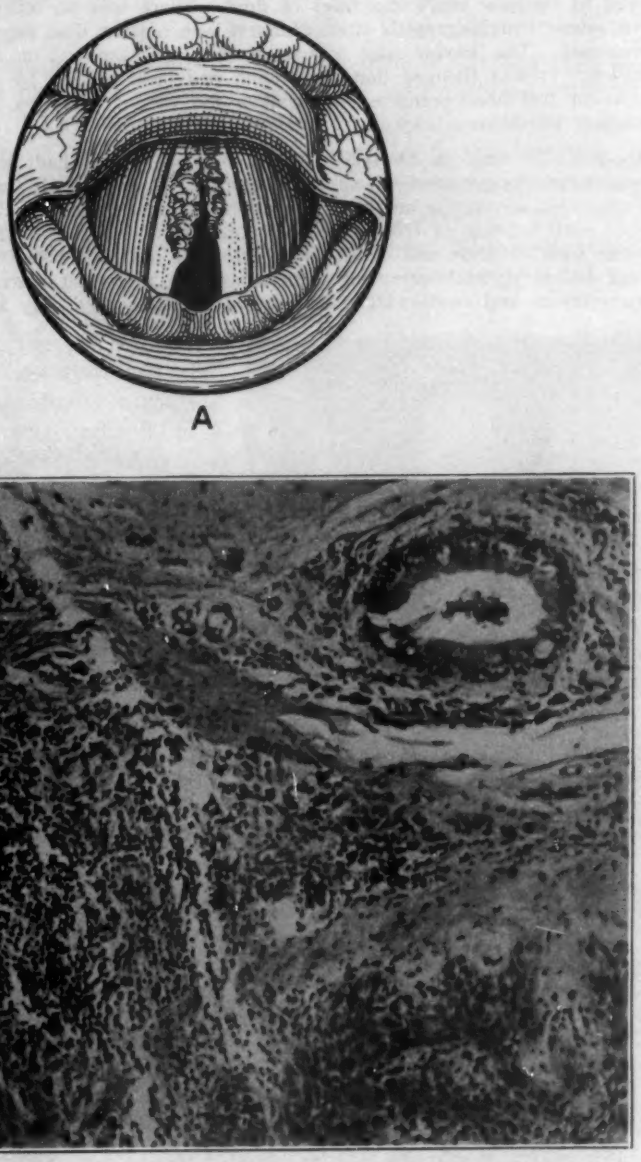

Fig. 6 (case 2).—*A*, extent of carcinoma. *B*, photomicrograph of squamous cell carcinoma; × 90.

REPORT OF CASES

Case 1.—A man of 63 years was admitted to the hospital with urgent laryngeal dyspnea, for which tracheotomy was necessary. A no. 8 tube was inserted into the lower part of the trachea. Examination of the larynx revealed marked reduction of the airway caused by a growth which occupied both vocal cords and extended into the anterior commissure. In addition there was some involvement of the left side subglottically. The patient stated that he had experienced progressive hoarseness for two years and that he had first had difficulty with breathing two months before admission. Laryngectomy was performed five weeks after

tracheotomy, according to the technic described. The epiglottis, being uninvolved, was left in place.

The patient had no appreciable reaction to the operation; he was allowed out of bed on the following day. The cutaneous clips were removed on the fifth day, at which time he was allowed to swallow small quantities of fluid. There was no leakage, but two days later he had a severe coughing spell, after which it was noticed that the lower angle of the wound had opened. The Levine tube was reinserted and removed on the twenty-sixth day after operation. It was thought that the wound had been healing by primary intention and that the patient had been permitted to swallow too early, causing a rupture of the wound and subsequent infection.

CASE 2.—A man of 53 years, in fairly good health, had been hoarse for four years. Laryngoscopic examination revealed cancer of both vocal cords, extending into the ventricles and anteriorly across the midline. Operation was performed with the patient under anesthesia induced with solution of tribromoethanol supplemented by local infiltration with a solution of procaine hydrochloride and epinephrine. He was out of bed the second day after operation. Except for mild tracheobronchitis, there was no untoward reaction. Healing occurred by primary union, and swallowing was resumed on the seventh day after operation.

136 East Sixty-Fourth Street.

SCULPTURALLY MOLDED SYNTHETIC IMPLANTS IN PLASTIC SURGERY

ADOLPH M. BROWN, M.D.
CHICAGO

As plastic surgery has progressed, various aterials have been used for surgical implants signed to raise the skin and obliterate facial fects caused by loss of tissue. The materials ost commonly used have been:

1. Paraffin. Paraffin has been used in saddle ses in the form of a heavy oil or a wax with ow melting point. It was injected under the n with a syringe, molded to shape with the gers and permitted to solidify. This procedure isfied the esthetic desires of the patient and the doctor, but the effects were transient at st. The paraffinoma which almost always sulted from this maneuver was difficult to move and tended to become carcinomatous. the procedure is a relatively easy one, unilled and unscrupulous operators have even ected this material into the saddle noses of philitic patients (fig. 1).

2. Celluloid.

3. Ivory. Celluloid and ivory, synthetic and imal material, are relatively inert and are relaely well tolerated, but they must be carved by nd to fit the defects, and sculptural modeling these materials is difficult.

4. Fascia and fat grafts. These grafts tend be absorbed and obviously are not easy to old satisfactorily.

5. Bone. This is generally used as a homonous material. It is usually conceded (Naffger[1]; Kolodny[2]) that eventually the graft is sorbed so that only a thick fibrous portion of remains. It is doubtful that this would main-n the contour that the surgeon intends.

6. Autogenous cartilage grafts.

7. Homogenous cartilage grafts. The diffities of cartilage implants are these: Whether togenous or homogenous, the cartilage must carved. The sculpture of this material can be rformed only crudely and within exasperating limitations. Regardless of how the cartilage is carved, the cells are arranged in a definite grain of their own, and curling occurs too often. Because of the limitations of the size and the shape of this material it is practically impossible to sculpture secondary curves such as the graceful curves of the glabella of the nose. Outside of straight lines, graceful lines are difficult to attain. Furthermore, the carving must be done under sterile conditions. At least some of it must be done at the operating table under the almost always urgent atmosphere of the operating room where assistants under pressure of heavy schedules must stand about and wait while the surgeon carves his implant as best he can. It is not conducive to smooth cooperative action in the surgical room. Again, the sculpture is limited to the configuration of the donor ribs and bones.

Fig. 1.—Paraffinoma caused by an attempt to correct a saddle nose by injecting paraffin under the skin. Diagnosis: syphilis.

Being interested in the accurate and artistic surgical molding of nasal tissue, I decided to use an acrylic resin implant. Acrylic resin plates

From the Illinois Eye and Ear Infirmary, University Illinois.

1. Naffziger, H. C., in discussion on Grant, F. C., Norcross, N. C.: Repair of Cranial Defects by anioplasty, Ann. Surg. **110**:511, 1939; The Restoran of Defects of the Skull, ibid. **104**:321, 1936.

2. Kolodny, A.: Osteoplastic Repair of Cranial fects, Am. J. Surg. **46**:365, 1939.

were successfully used by Walker, Taggart and Lambros.[3] They recommend acrylic resin as an inert material suitable for the repair of skull defects. We have used acrylic resin as a material for the construction of facial prostheses and found that once sculptured to shape by thermoplastic molding technics it became an inert, well tolerated external prosthetic material.

Implants for the nose made of foreign material have caused reaction in the surrounding tissues after a time, some extruding naturally in a flood of serosanguinous exudate. Implants of live animal material autogenous in origin tend to be absorbed by the host tissue. Implants of live animal material, such as homogenous cartilage, tend to be either absorbed or extruded.

Fig. 2.—*A,* positive plaster cast of a saddle nose corrected first by sculpturing with clay. The clay rod alongside the nose will provide a columellar strut if this is needed. *B,* hard plaster die and counterdie with the molded implant. The implant is later trimmed, riddled with drill holes and polished.

It seems as if the more inert the implanted material is, the better it is tolerated. Costal cartilage with its small number of cells and relatively great portion of undifferentiated matrix comes near to this classification of inert material. Yet, as already stated, it is difficult to carve.

Acrylic resins have come into use only in the past few years. They are the lightest of plastic materials, with a specific gravity of 1.8. Acr resins are polymeric esters (polymers) acrylic acid (CH_2:CH.COOH) and of me crylic acid (CH:C-OOH).

These synthetic products have shown st properties and in solid form, especially as p merized methyl methacrylate (lucite, crysta plexiglass), furnish a water-clear, light we thermoplastic material which should prove us in plastic surgery.

The acrylic resin is generally supplied a granular powder, or polymer, and as a liquid monomer. Essentially, these are mixed to fo a paste which is processed by molding and tr ing with heat to form an implant material wh we have found to be clean, light weight, c trolled as to color (or transparent), stable a well tolerated by the host tissue.

TECHNIC

First the patient's face is coated with a thin ap cation of petrolatum. This is applied thinly over skin and thickly over the eyelashes and the eyebr The nostrils are not plugged. The interior of e nostril is coated with petrolatum also. A batch no. 1 molding plaster is now prepared and rap spatulated to accelerate its setting time. This is sp over the face. A small quantity is forced into e nostril and permitted to remain a moment; then patient is directed to exhale through the nose slow This gives the patient an airway and at the same ti preserves the outline of the external and vestib nares. When this is hardened, forming a nega impression of the face with its defect, it is remo The contact surface of the negative impression m recoated with a thin layer of petrolatum or a co mercial separating compound when it is ready for preparation of the positive cast.

For the positive reproduction of the deformity de stone or preferably alpha gypsum (calcium sulf is mixed with water to form a creamy paste and poured into a negative cast. In order that the pla may not run through the openings of the nostrils the negative, these holes are plugged with model clay. When the plaster hardens, the negative positive impressions are separated, and the nega one is discarded. The positive one is now ready sculpture.

I prefer to use modeling clay as a medium sculpture because I am most familiar with this mater However, dental wax or plasticine may be used find that modeling clay is clean and permits a free of movement for the sculptor which is difficult attain with the use of dental wax. When model in dental wax one is forced to use small quanti of molten material; this results in what is known tight sculpture. The lines, planes and curves tend lack the fulness and gracefulness which can be obta when one is working with clay. Clay is a dependa sculptural material which has proved itself thro centuries of use.

3. Walker, A. E.; Taggart, J. K., Jr., and Lambros, V. S., cited by Lambros, V. S.: Repair of Large Cranial Defects, Arch. Surg. **46**:575 (April) 1943.

If the implant is to be one to correct a defect of nose, the implant made of plastic material which moldable proves its superiority to those of cartilage, e and fascia the moment the plastic surgeon begins sculpturing. The clay is placed over the defect may be modeled with all the planes, primary flexes and secondary curves which are necessary to ke the organ esthetically desirable.

normal persons. But this rule is not made to be followed rigidly, for a feminine nose, if the chin is delicate, may sometimes be more acceptable if it is slightly retroussé, and most men find a generous nose more appealing. It must be kept in mind when one is engaged in solving the problems of artistic anatomy that the patient most often misguidedly feels that he wants overcorrection of the defect. The patient with

Fig. 3.—*A*, positive plaster cast of a face with a receding chin. *B*, chin implant being modeled in clay on the itive plaster cast. *C*, model of the implant sculptured in clay on the plaster chin. *D*, finished molded acrylic n implant and the original positive cast shown together.

Obviously, if the surgeon is an esthete, it is an ntage. A profile photograph of the patient's face ded into areas of vertical dimension and anteroterior dimension is a help toward establishing an aling profile with the implant. On this profile tograph a line is drawn through the anterior edge the forehead and that of the chin. Another line n the glabella to the tip of the nose forms an angle approximately 30 degrees with the first line in a saddle nose admires a large hawk nose. This must be kept in mind while the sculpturing is in progress, and to a certain extent the esthetic wants of the patient must be resisted.[4]

Once the sculpture in clay is finished, key holes are dug here and there in the unsculptured portion of the positive cast. The positive cast with its sculptured

4. Brown, A. M.: Plastic Operations for Hump Nose, Arch. Otolaryng. **31**:827 (May) 1940.

correction is now lightly coated with petrolatum. Another batch of alpha gypsum paste is prepared and poured over this ensemble to form the second half of the mold. When this has solidified, the two halves of the mold are separated, and the clay is washed out leaving a die and a counterdie for the manufacture of the methyl methacrylate implant.

fluid.[5] A quantity of the powdered polymer, or tra
parent methyl methacrylate, is placed in a medic
glass and sufficient plasticizer, or liquid monomer,
added to saturate and cover the powder. This is p
mitted to stand for five or ten minutes. It is n
packed into its proper recess in the mold. A pi
of wet cellophane is laid over it. The two halves

Fig. 4.—*A*, dish face deformity. A cartilage implant is in this nose. *B*, front view of the dish face deform
Note the curling of the old cartilage implant.

Fig. 5.—*A*, profile after insertion of a sculpturally molded implant. Note that the distance from the eye
the root of the nose is increased. Note also the more graceful profile. *B*, front view after the substitution o
sculpturally constructed implant for the old cartilage graft.

The petrolatum is floated off by immersing the two halves of the mold in running hot water. The plaster die and the counterdie are permitted to dry. The inner surface of each is then covered with lead foil, cellophane or a commercial acrylic investment-separating

the mold are pressed together and then separated,
the excess material and the cellophane removed.
two halves of the mold are again assembled as a

5. This is marketed under the trade name Film-
by Justi and Son, Inc., of Philadelphia.

a counterdie with the plastic composition embedded
veen them.
his ensemble is now placed in a vulcanizing press
immersed in water, which is brought to boil. The
tment by heat is continued for about thirty minutes,
e or less, depending on the size of the implant.
he cast implant is then removed, and the edges are
med with a file or on a carborundum wheel. Holes
ut 1/32 inch (0.08 cm.) in diameter are drilled here
there through the sculptured piece, and then it is
shed.
he surgical implantation of sculpturally molded
hyl methacrylate implants is about the same as
of other implants. The incision may have to be
tly larger because the impression possesses planes
secondary curves which are impossible to attain
cartilage. Care should be exercised that the

1. They are stable.
2. They are well tolerated by the host tissue.
3. They are light in weight.
4. They are easily molded to *follow all sculptural planes* desired.
5. They are not limited in size and shape as are autogenous and homogenous grafts to the previous configuration and size of donor ribs and bones.
6. They do not change size.
7. They do not alter the color of the skin.
8. They are more adaptable to the base of the defect. They do not slip.

ig. 6.—*A*, receding chin. *B*, patient with a sculpturally molded synthetic implant to correct the receding chin.

ket surgically provided is sufficient in dimensions
llow for relaxed skin over the implant. Again, the
geon need not be so concerned about too much
ercutting of the skin lest his implant slip or curl;
molded implant fits better than the crudely carved
e implant. We believe that an opening made
le the edge of the vestibule of the nose is the
sion of choice for a nasal implant. As in any
r operation for placing an implant, hematoma must
guarded against.

SUMMARY

Methyl methacrylate is a useful material for
lded implants to correct facial defects. Such
lants have the following advantages:

9. They do not change in shape; they do not curl.
10. The technic of their construction is not too complicated or expensive.

NOTE.—Methyl methacrylate implants are transparent to roentgen rays. Methyl methacrylate is sensitive to alcohols and ketones. Therefore I sterilize the implant by immersing it in mercury bichloride solution. Diabetic patients are not good candidates for acrylic resin implants.

540 North Michigan Avenue.

Case Reports

CEREBROSPINAL RHINORRHEA ASSOCIATED WITH CRANIOPHARYNGIOMA AND MENINGITIS

Report of a Case

ISIDORE BERGER, M.D., NEW YORK

Although the subject of cerebrospinal rhinorrhea was referred to in English medical literature in the early part of the nineteenth century, it was not until 1899 that it was brought to medical attention by Sir St. Clair Thomson.

This condition is a symptom per se but is to be considered with apprehension by both the patient and the physician since it is often the forerunner as well as the concomitant of serious intracranial abnormality. The fluid presents the character of spinal fluid, being odorless, tasteless and colorless, and when it is boiled with Fehling's copper sulfate solution reduction occurs with deposit of cuprous oxide. It is further differentiated from the fluid of ordinary rhinorrhea by its lack of mucin and practically of albumin. It leaves a handkerchief unstiffened and dry in due course. Chemical examination of the fluid in the fresh state is important as alteration and absorption of the contents may occur.[1]

The pathologic basis for cerebrospinal rhinorrhea in the more serious cases is increased intracranial pressure with formation of a bony fistula in the floor of the anterior fossa of the skull, the cause of which is a space-taking cerebral lesion. An infection of the upper respiratory tract, such as the ordinary cold or influenza, overmanipulative nasal care or an infected polyp may be the initiating factor for complication such as meningitis or abscess of the brain.

The bony fistulous tract may lead through the cribriform plate, the ethmoid labyrinth or the sphenoid sinus. The dura over these areas is adherent and tight so that it tears easily and becomes atrophied from pressure. Atrophy and defects of bone also occur from intracranial conditions causing extreme pressure, with consequent flow of cerebrospinal fluid through the roof of the nasal chambers.

There is also the so-called spontaneous cerebrospinal rhinorrhea the pathogenesis of which is not definite and which often clears up.

Shea[2] reported three autopsies revealing specific causative factors of cerebrospinal rhinorrhea: (1) a basal fracture of the skull with dural tear; (2) a pituitary tumor of the sella tur with erosion of the clinoid processes and a de in the floor of the sella opening into the sphe sinus; (3) an erosion of the right eth labyrinth following arachnoiditis, causing inte hydrocephalus with consequent pressure thinning of dura and bone.

Wessels[3] reported a case in which a fistul the floor of the anterior fossa extended thro the left cribriform plate, found by Dr. E. S on operative exposure.

In an opinion ventured in an article Titche,[4] hyperostosis frontalis interna, found roentgen examination, may have been respons due to stretching and tearing of the dura.

Som and Kramer[5] in their studies foun pituitary tumor responsible for a fistulous t from the floor of the anterior fossa to the olfact recess with dural herniation as part of the flamed polypus seen endonasally. The latter m have been the portal of entry for meningi In another instance, osteomyelitis of the poste wall of the sphenoid sinus with erosion of dura was found. A submucosal abscess was c sidered the cause of the meningitis.

Perot[6] noted a tumor of the cerebral fro lobe in association with cerebrospinal rhinorr

Friedberg and Galloway[7] are of the opin that in "spontaneous cases" the fluid esca along the perineural sheaths of the olfact nerves, especially following violent sneezing suggested by Wagner-Jauregg.

REPORT OF CASE

Mrs. H. G. C., a Negro woman aged 31, visited Ear, Nose and Throat Outpatient Dispensary of Ha Hospital in April 1943 complaining of a profuse wa discharge from the right nasal chamber, hyposmia frontal headaches, all of which interfered with her fessional duties as a nurse.

From the otolaryngologic service of Dr. H. J. Burman, Harlem Hospital.

1. Thomson, St. C., and Negus, V. E.: Diseases of the Nose and Throat, ed. 4, New York, D. Appleton-Century Company, Inc., 1937.

2. Shea, J. J.: Cerebrospinal Rhinorrhoea with Autopsy Report, Ann. Otol., Rhin. & Laryng. **47**:253-260 (March) 1938.

3. Wessels, A.: Report of a Case of Spontan Cerebrospinal Rhinorrhoea with Operative Cure, A Otol., Rhin. & Laryng. **48**:528-530 (June) 1939.

4. Titche, L. L.: Cerebrospinal Rhinorrhoea: port of Case Presenting Hyperostosis Frontalis Int Ann. Otol., Rhin. & Laryng. **50**:554-560 (June)

5. Som, L., and Kramer, R.: Cerebrospinal Rhi rhoea: Pathological Findings, Laryngoscope **50**:1 1177 (Dec.) 1940.

6. Perot, P. L.: Cerebrospinal Rhinorrhoea, N Orleans M. & S. J. **94**:27-29 (July) 1941.

7. Friedberg, S. A., and Galloway, T. C.: Sp taneous Cerebrospinal Rhinorrhoea, Ann. Otol., Rhi Laryng. **47**:792-794 (Sept.) 1938.

ie had been admitted to the Vanderbilt Clinic on Oct. 1940, complaining of amenorrhea, flushes of heat over body, headaches and momentary blurring of vision. er father had syphilis, and her mother had several arriages and stillbirths.

he patient in her childhood had exanthems and erwent tonsillectomy. In 1932 her blood was found show a positive Wassermann reaction. She was ted for two years with arsenical and bismuth com-nds, which resulted in a reversal of this serologic

ntgenograms showing involvement of the sella ca in a large calcified mass with distortion and ption of the clinoid processes.

g. In 1937 she had pulmonary tuberculosis, and nothorax was performed on the right side at River-Hospital, with subsequent arrest of the tuberculous ss and with the sputum becoming free of bacilli. s still under observation for the same condition.

1940, while she was at the Vanderbilt Clinic, she found to have a tumor of the brain. For this ceived roentgen therapy and preparations of thyroid pituitary glands. These treatments were stopped few years, and then, in April 1943, the nasal watery arge developed.

PITUITARY TRACTS

The results of examinations at Harlem Hospital, including the ears, the nose and the throat, and the various laboratory data coincided with those obtained at the Vanderbilt Clinic and were as follows:

The patient was right handed, with no defects of gait, muscle status or strength. The tendon reflexes were normal, and the cranial nerves were intact. No sensory changes were observed.

The visual fields showed a left homonymous upper quadrantic defect, while the electroencephalogram presented an abnormal record simulating that of deep midline lesions but of no localizing value.

The hemoglobin content of the blood was 11.6 Gm. (80 per cent). A blood smear was normal. The white cell count was 6,600, with polymorphonuclears 67, lymphocytes 29, monocytes 3 and eosinophils 1 per cent. The nonprotein nitrogen in the blood amounted to 30 mg. and the sugar to 96 mg. per hundred cubic centimeters. The Kline test of the blood was 2 plus; the Wassermann test with an alcoholic antigen was negative. The spinal fluid showed 2 white cells and 12 red cells and a total protein content of 22 mg. per hundred cubic centimeters. The colloidal gold curve was 1100000000; the Wassermann reaction was negative in all dilutions.

Chemical analysis of the nasal discharge was first attempted under my auspices, as cerebrospinal rhinorrhea was suspected; it revealed a colorless, odorless fluid of slight alkaline reaction with a positive reduction in Fehling's test but a very slight positive reaction for albumin and globulin and therefore was suggestive of spinal fluid.

In roentgen examination of the sella turcica there was presented a large calcified mass with distortion and absorption of the clinoid processes (figure).

Mirror visualization and palpatory examination of the nasopharyngeal vault revealed a large hardened mass.

In such a case treatment must be directed toward the intracranial condition. The services of a neurosurgeon may be required as the cerebral mass may be operable or there may be a possibility of plastic repair of an evident traumatic fistula revealed by roentgenogram or on operative exposure.

If the mass is inoperable, roentgen irradiation of the tumor and endocrine therapy may be called for as in this case of craniopharyngioma. Spinal tap relieves the intracranial tension. Exposure and colds, as well as overmanipulative nasal care, must be guarded against. Chemotherapy will help control intracranial complications, as was the case when meningitis developed in this patient. Perot[6] suggested the use of a 20 per cent solution of silver nitrate for the so-called spontaneous cerebrospinal rhinorrhea in the hope of producing edema and adhesions in the olfactory sulcus to ward off the flow of fluid.

SUMMARY

In cases of cerebrospinal rhinorrhea in association with a craniopharyngioma such as that presented, the patient must be under careful scrutiny because of intracranial complications. Chemical examination of the nasal discharge is of paramount importance as an aid to diagnosis.

888 Grand Concourse.

Clinical Notes; New Instruments and Technics

NEW INSTRUMENT FOR USE IN RHINOPLASTIC SURGERY

REUBEN KAYSER, M.D.
Assistant Surgeon, Brooklyn Eye and Ear Hospital
BROOKLYN

The instrument was presented before the Otolaryngological Section of the Medical Society of the County of Kings and the Academy of Medicine of Brooklyn on Nov. 10, 1943. It was also presented at the annual meeting of the American Rhinological Society for the Advancement of Plastic and Reconstructive Surgery and the Academy of Medicine of New York on Nov. 12, 1943.

The new instrument has been devised to serve a twofold purpose. One end enables the rhinoplastic surgeon to (1) present to direct view the lower lateral cartilage and (2) to section it exactly as desired with one sweep of the knife.

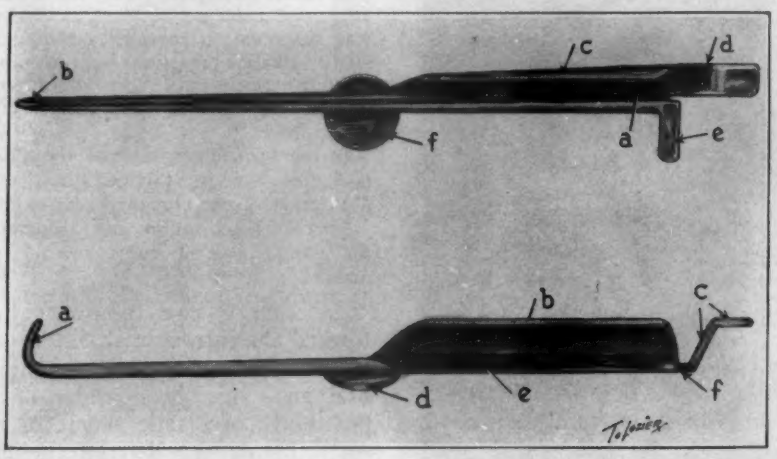

Fig. 1.—Bird's-eye view of the director is shown above. Note (*a*) groove, (*b*) groove extending into hook, (*c*) flange elevator, (*d*) angulated rest plate, (*e*) pivot rest and (*f*) button finger rest.

Below is shown the left lateral view. Note (*a*) hook, (*b*) flanger elevator, (*c*) angulated rest plate, (*d*) button finger rest, (*e*) abrupt taper and (*f*) pivot rest.

It eliminates any danger of the knife slipping, any deviation from the predetermined line of incision or any nicking of the rim of the nostril.

The other end of the instrument enables the surgeon to trim the dorsum of the septal cartilage at a desired level and to have that level on an even plane.

FIRST USE OF INSTRUMENT

1. The external skin and subcutaneous tissues are first elevated from the lower lateral cartilages.

2. The soft tissues are then retracted with a two-pronged retractor.

3. At the caudad margin of the lower lateral cartilage, a dural hook is inserted at whatever point one has determined to section the margin.

4. The hook end of the director is then inserted into the nostril, passed through the intercartilaginous incision and hooked around the cephalad margin of the lower lateral cartilage.

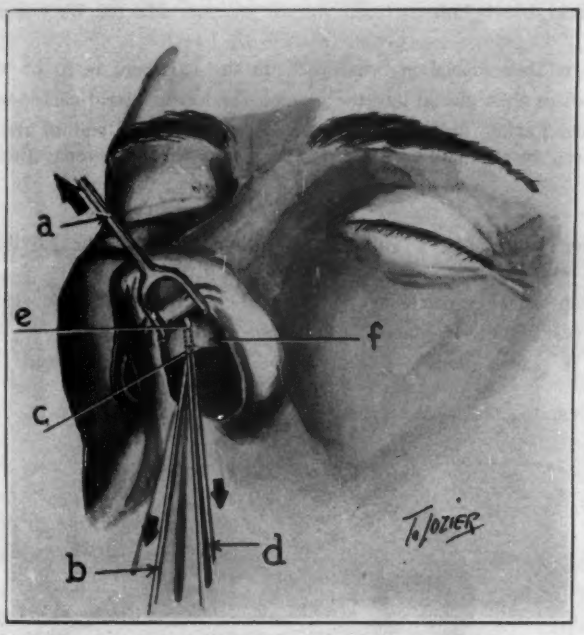

Fig. 2.—Instrument being put in use. Note (*a*) two-pronged retractor, (*b*) dural hook, (*c*) caudad margin engaged by dural hook at apex of angle, (*d*) director, (*e*) cephalad margin engaged by hook of director and (*f*) lower lateral cartilage exposed.

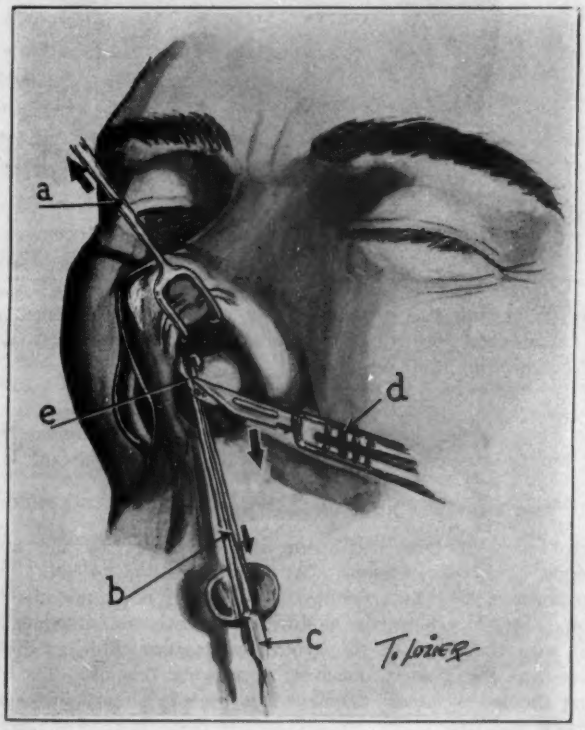

Fig. 3.—Cutting the cartilage. Note (*a*) two-pronged retractor, (*b*) director, (*c*) dural hook resting in groove of director, (*d*) no. 11 Bard-Parker knife and (*e*) knife in groove sectioning the cartilage.

5. The lower lateral cartilage is then drawn by the director out of its bed for direct inspection.

6. The director is then placed at whatever site the cartilage is to be split.

7. The dural hook is then placed into the groove, the lower lateral cartilage being drawn taut.

8. A no. 11 Bard-Parker knife is now inserted at the upper end of the groove, and with one downward sweep of the knife, the cartilage is cut through, separating the medial from the lateral crus.

SECOND USE OF INSTRUMENT

Occasionally, one would like a guide to get the dorsum of the cartilaginous septum on an even plane. This can be accomplished with this director:

1. The distal end of the director is rested on the bony part of the septum.

2. The "pivot rest" plate is placed against the septum itself.

3. The groove is placed along the side of the septum at the desired level.

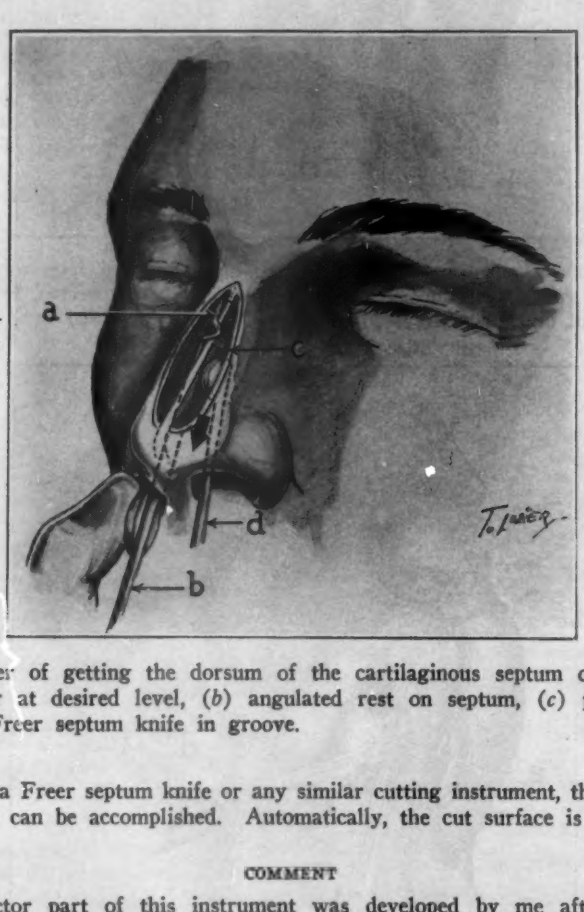

Fig. 4.—Manner of getting the dorsum of the cartilaginous septum on an even plane. Note (*a*) director at desired level, (*b*) angulated rest on septum, (*c*) pivot rest against septum and (*d*) Freer septum knife in groove.

4. With either a Freer septum knife or any similar cutting instrument, the desired removal of septal cartilage can be accomplished. Automatically, the cut surface is on a level plane.

COMMENT

The hook-director part of this instrument was developed by me after observing and evaluating work done by other surgeons. At the suggestion of Dr. V. Syracuse, of the Fomon group, a strabismus hook was employed. This did not guide the knife accurately in the line of incision. Dr. H. Neivert's modification consisted of using a groove director, curved at one end, with the angle of the groove cut away. This avoided dulling the edge of the knife. There was the danger, however, of nicking the ala. The director here illustrated for sectioning the lower lateral cartilage has been employed successfully by S. Fomon and the Fomon group.

442 Bay Ridge Parkway (Seventy-Fifth Street).

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

ALLERGY

ERNEST L. MacQUIDDY, M.D.
OMAHA

GENERAL CONSIDERATIONS

ooke[1] discussed the protein derivatives hista-, proteose and nucleic acid as factors in gy. He concluded his discussion of hista- with this statement: ". . . with regard linical studies, my results are not in accord most of those reported. I find no unrespon- phase in urticaria [it has been assumed that spontaneous urticarial wheal appears in a in area, it will not reappear in that area for y-six to forty-eight hours], no increase of ance to histamine, no clinical result in nic urticaria and no evidence that histamine creased in the blood during general allergic tions." Regarding proteose, he expressed the f that clinical sensitization to derivatives of digestion of protein, at least to those in the eose state, existed. Regarding nucleic acid he d that in his clinic certain patients sensitive agweed had been tested with nucleic acid and tive reactions had been obtained. These re- s confirmed the work of Winkenwerder and workers.[2] He stated that the significance of positive nucleic acid tests is not clear as yet. Urbach[3] classified endogenous allergy. He ded his endogenous allergens into (1) auto- ogenous allergens and (2) heteroendogenous rgens. The first group he subdivided into primary, those which originate directly from ased tissue or abnormal endocrine products, (*b*) secondary, those formed by tissues which e been sensitized either by exogenous or by ogenous allergens so that as a result of a ere reaction their proteins have been rendered ign to the organism. The heteroendogenous rgens comprise the group which arise within body but are not derived from the body's n substance. The chief sources of allergens this group are infectious and parasitic agents.

Frank, Blahd and Howell[4] found by experimental means that the mucous membrane of the upper respiratory tract could be readily sensitized by various indirect routes. It could be sensitized via many portals, including other mucous membranes. They also found that foreign substances introduced into the nasal sinuses, without injury to the mucous membrane, sensitized such distant areas as the skin and other mucous membranes.

NASAL ALLERGIES

In a paper on nasal glands Brunner[5] investigated the cytologic character of the hyperplastic nasal mucous membrane. He found that the hyperplastic mucous membrane of the nose may contain (*a*) normal glands, (*b*) hyperactive glands with or without retention of secretion and (*c*) atrophic glands. The hyperactivity concerned chiefly the mucous glands and might lead to (*a*) exhaustion (*b*) rupture of the glands or (*c*) formation of cysts. Exhaustion in turn led to atrophy. The first evidence of the effect exerted on the glands by the edema of the nasal polypi is complete or almost complete cessation of the production of mucus in the epithelium as well as in the glands. The same dysfunction of glands was found by other investigators in the bronchial mucous membrane of patients who succumbed to allergic asthma and in the salivary glands after dissection of the secretory nerves. It was this author's belief that one of the commonest causes of hyperplastic rhinitis was allergy. Among the 68 cases in which his material was obtained there was definite eosinophilia in only 14. Even though eosinophilia was found in only 14 of the 68 cases, Brunner stated that allergy plays an important part in nasal disease and that definite eosinophilia certainly points in this direction.

1. Cooke, R. A.: Protein Derivatives and Allergy, n. Int. Med. **16**:71-80, 1942.

2. Winkenwerder, W. L.; Buell, M. V., and Howard, E.: Sensitizing Properties of Nucleic Acids and ir Derivatives, Science **90**:356, 1939.

3. Urbach, E.: Endogenous Allergy, Arch. Dermat. Syph. **45**:697-722 (April) 1942.

4. Frank, I.; Blahd, M., and Howell, K. M.: Experimental Hypersensitivity of Mucous Membranes of Upper Respiratory Tract, Arch. Otolaryng. **35**:918-921 (June) 1942.

5. Brunner, H.: Nasal Glands, Arch. Otolaryng. **35**:183-209 (Feb.) 1942.

Cahn-Bronner [6] discussed the local resistance of nasal mucosa to bacterial infection. He mentioned that the upper part of the nose may contain far fewer bacteria than would be expected, that artificially introduced bacteria may disappear quickly from the surface of the mucosa and that accidental and surgical wounds rarely become infected. He stated that in his opinion, besides the mechanical action of the ciliated epithelium and drainage, lysozyme can be considered one of the most important factors in local tissue resistance. He found that lysozyme disappeared or decreased heavily during the first two to four days of a common cold. The discharge from the running nose of patients with hay fever showed, however, a high lysozyme content. It has been known since 1909 that there was a lytic substance in egg white, in leukocytic extract and in saliva. Fleming [7] in 1922 brought out the remarkable potency and widespread nature of this lytic substance and called it lysozyme. He first noticed lysozyme during some investigations on a patient suffering from acute coryza. Thompson [8] in 1940 reviewed the literature on lysozyme and also discussed its presence in nasal secretions.

Deamer [9] discussed allergic rhinitis in children and estimated that 7 per cent of the practice of pediatricians is in the field of allergy. In taking a history the physician must ask about asthma, not so much by name as by the symptoms it causes: chronic recurrent cough, occasional wheezing with or without obvious dyspnea, or wheezing and dyspnea on exertion. He cited as the cardinal symptoms of nasal allergy sneezing, rubbing the nose because it itches and nasal congestion, and noted that the characteristic time of day for sneezing and nasal congestion to occur is between waking and breakfast. The tendency for allergic rhinitis to be intensified at the time of an asthmatic attack has done much to foster the belief that an infection of the upper respiratory tract has much more to do with asthma than is usually the case. In the allergic child nasal symptoms are more or less constant. He urged that eosinophilia be looked for in establishing a diagnosis. As an aid to treatment he suggested a study of the child's environment, the removal of pets and the use of dust-free bedrooms. In cases of seve sensitivity to house dust immunization by hou dust should be tried. This should not be tri however, without the elimination of all oth possible sources of dust. In those patients w are not relieved or who are only partially relie by the environmental changes food allergy is be suspected, particularly if repeated abdomi pain or repeated headache is given as a part the patient's history.

Urbach and Gottlieb [10] discussed the relati of vasomotor rhinitis to asthma and found t it was associated in 38 per cent of the cas studied. If vasomotor rhinitis appeared with t asthma or within two years before or after t asthma, the conditions were usually due to t same cause. When the nasal condition appea many years before or after the development asthma the two conditions were due to differe causes in the majority of cases. These autho also called attention to the use of the na mucosa as a site for testing and treatment of t asthma.

ODORS

Urbach [11] investigated osmyls as allergen agents. The term "osmyl" denotes any kind odor, pleasant or unpleasant. He concluded the basis of chemical, physical and physiolo observations that scent, whether organic or in ganic in origin, has a physiochemical basis a is propagated by minute particles. Accordingl osmyls on inhalation could act as allergens in ce tain cases. He described the preparation of the substances for testing and for oral administrati in desensitization.

ORAL THERAPY

Iliff and Gay [12] reviewed oral treatment of h fever with regard to certain pollens and co cluded that of 82 patients treated, 3 obtain excellent relief, 10 had good results, 39 had f benefits, 25 failed to obtain any relief and stopped treatment because of untoward reactio The reactions, although frequent, were for t most part not severe and were fairly readily co trolled. Almost all the symptoms were gastr intestinal, and no dangerous reactions were e countered. The material used in the work w pollen prepared in capsules in graduated dos

6. Cahn-Bronner, C. E.: The Presence and Action of Lysozyme in the Nasal Mucosa, Ann. Otol., Rhin. & Laryng. **51**:250-252, 1942.

7. Fleming, A.: On a Remarkable Bacteriolytic Element Found in Tissues and Secretions, Proc. Roy. Soc., London, s.B **93**:306-317, 1922.

8. Thompson, R.: Lysozyme and Its Relation to the Antibacterial Properties of Various Tissues and Secretions, Arch. Path. **30**:1096-1134 (Nov.) 1940.

9. Deamer, W. C.: Asthma and Allergic Rhinitis in Childhood, Clinics **1**:655-668, 1942.

10. Urbach, E., and Gottlieb, P. M.: Relation Vasomotor Rhinitis to Bronchial Asthma, Arch. Ped **59**:382-388, 1942.

11. Urbach, E.: Odors, Osmyls as Allergenic Age J. Allergy **13**:387-396, 1942.

12. Iliff, E. H., and Gay, L. N.: Oral Treatm with Ragweed Pollen, Bull. Johns Hopkins Hosp. 7 378-385, 1942.

Clements [13] reported on the oral treatment for perennial hay fever. His paper concerned only a series of patients who gave positive reactions when tested with an extract of house dust. He was of the opinion that the specific antigen in the extract was similar to, if not the same as, that found in an extract of cotton mattress. He used the extract of cotton mattress orally in the desensitization of 150 patients. Forty of these patients failed to complete the treatment outlined; 92 reported complete relief from symptoms, 20 marked but incomplete relief, 12 partial relief and 10 no relief.

OTHER TREATMENT

Rockwell [14a] commented on the use of a pollen antigen hydrochloride [14b] and stated that this preparation has the following advantages: It is a purified antigen, can be more accurately standarized, is slowly absorbed, gives a high degree of desensitization, allows the desensitization of highly sensitive patients who are difficult to treat with the crude extract and gives a good result with less than half the number of injections required in a similar group treated with the crude extract.

Means [15] reported on the use of colloid calcium gelatinate in seasonal allergies. This is placed directly in the nose and the eyes and is used coseasonally.

Howe [16] called attention to a syndrome frequently associated with nasal allergy in children which he termed hyponuclemia. He found that hyponuclemia usually resulted from a deficiency of nucleoproteins in the diet, from faulty gastrointestinal digestion or from a persistent leak of nucleic acid in the sinal and nasal discharges of subacute and chronic sinusitis. The clinical picture includes a pasty complexion, distinct pallor, excessive weight and an appearance of pseudorobustness. In addition to these symptoms there are loss of appetite, almost anorexia, sluggish mental and physical responses, indifference to play and surroundings, soft and unhealthy flesh and a somewhat retarded growth. Nucleic acid and a diet rich in nucleoproteins brought relief in a high percentage of these children. Improvement in the patients indicated to the author that deficiency of nucleic acid had existed.

Brighton, Snow and Friedman [17] gave an evaluation of short wave therapy as applied to sinusitis and allergic rhinitis and concluded that the therapy is of no value in the treatment of allergic rhinitis.

Golan and Sack [18] compared preseasonal and coseasonal therapy. They stated that in their 122 cases the results were the same in both groups and concluded that there is little value in giving pollen therapy on through the season if the patients have been properly prepared preseasonally. Sack and Golan [19] concluded in another article that the intensity of the individual suffering with hay fever due to ragweed corresponds in a general way to the rise and fall of the pollen curve.

Holmes and Alexander [20] reported the use of vitamin C in daily doses of 250 to 1,000 mg. in the treatment of hay fever and concluded that it is of value in this condition. This work has as yet not been confirmed by any other writers.

Ruskin [21] in 1938 called attention to the parallel action of calcium and vitamin C. He expressed the opinion that the combined properties of vitamin C and calcium would produce a new therapeutic agent in calcium therapy which would have greater solubility and absorbability and complete calcium action. In the same year Ruskin [22] advocated the use of calcium cevitamate for acute rhinitis. He listed among the cases of acute rhinitis several cases of vasomotor rhinitis, nasal allergy and allergic rhinitis, in all of which he stated the condition was definitely improved by the use of the new preparation, calcium cevitamate. In 1942 Ruskin [23] described the influence of vitamin C on the antihistamine action of epinephrine, ephedrine, benzedrine and calcium. He concluded that vitamin C plays a unique physiologic role, which in some respects, as in the instance of epinephrine, is perhaps a

13. Clements, R. M.: A Newer Treatment for Perennial Hay Fever, J. M. A. Alabama **11**:428-430, 1942.

14. Rockwell, G. E.: (*a*) Clinical Study with Pollen Antigen Hydrochloride, Ohio State M. J. **38**:433-434, 1942; (*b*) Preparation of a Slowly Absorbed Pollen Antigen, ibid. **37**:651-652, 1941.

15. Means, R. R.: Use of Colloidal Calcium Gelatinate in Seasonal Allergy, M. Rec. **155**:313-315, 1942.

16. Howe, A. C.: Nucleic Acid Treatment of Subacute and Chronic Sinusitis, Ann. Otol., Rhin. & Laryng. **51**:220-227, 1942.

17. Brighton, G. R.; Snow, W. B., and Friedman, H. S.: Short Wave Therapy in Treatment of Sinusitis and Allergic Rhinitis, J. A. M. A. **118**:507-510 (Feb. 14) 1942.

18. Golan, H. G., and Sack, S. S.: The Value of Continuing Preseasonal Therapy Through Pollen Season, J. Allergy **13**:300-306, 1942.

19. Sack, S. S., and Golan, H. G.: Relationship Between Clinical Symptoms and Pollen Count in Pollinosis, J. Allergy **13**:296-299, 1942.

20. Holmes, H. W., and Alexander, W.: Hay Fever and Vitamin C, Science **96**:497-499, 1942.

21. Ruskin, L.: Studies on Parallel Action of Vitamin C and Calcium, Am. J. Digest. Dis. **5**:408-411, 1938.

22. Ruskin, L.: Calcium Cevitamate in Treatment of Acute Rhinitis, Ann. Otol., Rhin. & Laryng. **47**:502-511, 1938.

23. Ruskin, L.: Influence of Vitamin C on Anti Histamine Action of Various Drugs, Arch. Otolaryng. **36**:853-873 (Dec.) 1942.

sparing action on the body reserves through enhancement of activity. In the case of calcium the vitamin evidently plays an inherent role in the physiologic activities of the element as well as in its chemical relationships. He stated that in the presence of a deficiency of vitamin C the therapeutic use of calcium may even be contraindicated. It appears from this experiment that the synergistic effect of vitamin C on calcium may be the all-deciding factor in the therapeutic value of calcium in allergy.

Bucher [24] suggested the treatment of vasomotor rhinitis and other allergic manifestations by means of an anterior pituitary extract, each dose being equivalent to 18.5 grains (1.19 Gm.) of the fresh gland. He does not state in just what form this pituitary extract is made available.

ALLERGY OF THE EYES

Lemoine [25] discussed the allergies from the point of view of ophthalmology. He discussed allergy of the eyes as observed in the lid, the conjunctiva, the cornea, the sclera, the uveal tract, the lens, the muscles, the retina and the optic nerve. It is his belief that the underlying cause of the disturbed biochemical and neurologic state of patients with allergy is an impairment of function of the pituitary and adrenal glands.

Long before the term "endogenous allergy" was coined certain diseases of the eye were considered as clinical expressions of autoanaphylaxis. Urbach [3] referred to articles in which it is assumed that the cause of sympathetic ophthalmia is sensitization to the organ-specific uveal pigment which as a result of trauma to the uvea has been destroyed and absorbed and that patients with sympathetic ophthalmia usually give positive cutaneous reactions to uveal pigment. One of the authors employed uveal pigment as a therapeutic agent in the treatment of this disease and reported good results. After operation on the lens, lens substance is liberated, and hypersensitivity to this protein may be considered as a possible cause of the endophthalmitis phacoanaphylactica which prevents complete healing after extraction of cataract. He cited authors who observed that desensitization with lens protein in patients who gave positive reactions to lens extract before operation tended to ameliorate or even to inhibit totally such postoperative inflammation. Furthermore, he continued, certain forms of keratitis parenchymatosa are said to be of endoallergic origin. In regard to these it is assumed that the patient has been allergized by absorption of corneal proteins released in the course of the first operation and the second operation (keratoplasty, iridectomy) elicits allergic inflammation of the cornea.

Knapp [26] investigated the use of vitamin D in the form of viosterol and the use of calcium in the form of mineral mixtures. The 43 patients studied presented various types of vernal catarrah. Forty-two of them showed definite improvement. He felt that there must be some disturbance of the vitamin D–calcium–phosphorus metabolism in vernal catarrh.

Cohen [27] reported a case of marked injection of vessels in the eyelids and bulbar conjunctiva caused by hypersensitiveness to house dust. He sensitization with an extract of house dust relieved the condition.

ALLERGY OF THE EAR

Noun [28] discussed 2 cases of chronic otorrhea which he felt were due to food sensitiveness. Elimination of the offending foods relieved the condition. He urged consideration of allergy as a cause of refractory otorrhea.

Mao [29] reviewed the results of tests for allergy on 535 resident pupils in the Pennsylvania School for the Deaf. Positive reactions were found in 28.5 per cent, while only 2 per cent showed definite clinical manifestations. He stated that the figure for deaf children is 27.41 per cent higher than that for the largest numerical group of children with normal hearing reported. He stated that it is not unreasonable to assume that allergy and deafness in combination have some mutual hereditary background.

HISTAMINE AND HISTAMINASE

Cooke [1] reported the therapeutic injection of histamine in 10 cases of urticaria, the treatment extending over periods of four to twelve weeks and stated that in no case did he obtain any improvement. Opposing this statement is the report of Farmer and Kauffman [30] on the use of histamine in cases of nasal allergy, both seasonal

24. Bucher, C. S.: Use of Anterior Pituitary Extract in Treatment of Allergy, Illinois M. J. **82**:202-205, 1942.

25. Lemoine, A. N.: Allergies in Ophthalmology, Arch. Ophth. **26**:79-92 (July) 1942.

26. Knapp, A. A.: Vitamin D in Vernal Catarrh, J. Allergy **13**:407-410, 1942.

27. Cohen, A. E.: Unusual Hypersensitiveness to House Dust in a Case of Allergic Conjunctivitis, Allergy **13**:170-172, 1942.

28. Noun, L. J.: Chronic Otorrhea Due to Food Sensitivity, J. Allergy **14**:82-86, 1942.

29. Mao, C. Y.: Allergy as Contributing Factor in Biologic Deafness, Arch. Otolaryng. **35**:582-586 (April) 1942.

30. Farmer, L., and Kauffman, R. E.: Histamine in Treatment of Nasal Allergy, Laryngoscope **52**:255-259, 1942.

perennial. They had been able to treat essfully patients suffering with seasonal and ennial rhinitis by repeated injections of histae. Vaisberg [31] reported on the use of histase in 19 cases of allergy. The results were encouraging. Reveno [32] reported on the use istaminase in 5 cases; 3 patients were unimved. From his limited experience in the use istaminase he would not place a high value it as a therapeutic agent.

BACILLUS COLI METABOLISM

n the two articles available on B. coli metabtherapy, by Shilkret [33] and Loveless and Baldwin [34] no evidence was given that it gave relief in allergic conditions, particularly hay fever.

GENERAL

Gordon [35] in an interesting article on allergy, enuresis and stammering stated that in his opinion enuresis and stammering are more frequent among allergic persons. He stated that it is suggested by his study that enuresis and stammering are not of themselves direct allergic manifestations but result from the abnormal psychologic traits of allergic persons.

478 Aquila Court.

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2. Reveno, W. S.: Observations on Parenteral Use Histaminase, Harper Hosp. Bull. **1**:69-70, 1942.

. Shilkret, H. H.: Bacillus Coli Metabolism, New k State J. Med. **42**:332-335, 1942.

34. Loveless, M. H., and Baldwin, H. S.: "Coli Metabolin" Therapy in Hay Fever: Psychogenic Benefits, J. A. M. A. **118**:451-453 (Feb. 7) 1942.

35. Gordon, I.: Allergy, Enuresis and Stammering, Brit. M. J. **1**:357-358, 1942.

Abstracts from Current Literature

Ear

ROENTGEN THERAPY IN OTITIS MEDIA. L. L. TITCHE and W. E. LAWSON, Am. J. Roentgenol. **47**:764 (May) 1942.

A second series of 52 cases in which otitis media was treated by means of roentgen rays is presented. A current of 85 kilovolts, 5 milliamperes was used with a 16 inch (40 cm.) target-skin distance and a 1 mm. aluminum filter. The dose was 50 to 60 r for infants, and for young children and adults the dose varied from 60 to 100 r. The therapy was successful in each case, shortening the course of acute uncomplicated otitis media by six days, and that of otitis media with complications by sixteen days. Thirty-three patients with acute catarrhal otitis media were given one treatment of 79.09 r (average). The drum was normal in an average of three days. In 14 cases of acute purulent otitis media with treatment on the average of 1.43 times and with an average dose of 71.23 r, a dry ear was attained in ten and a half days. In 5 cases of chronic purulent otitis media with an average of 1.68 treatments and an average dose of 76.49 r a dry ear was attained in fourteen days.

No ill effects have yet been noted in a total of 110 cases thus far reported.

SQUIRE, Chicago. [AM. J. DIS. CHILD.]

HISTAMINE IN TREATMENT OF MÉNIÈRE'S SYNDROME. JOHN J. RAINEY, J. A. M. A. **122**:850 (July 24) 1943.

Rainey discusses Ménière's syndrome briefly with some historical data on this condition. He has observed 22 patients with the syndrome since December 1940 and has treated them by intravenous injections of histamine phosphate, with striking results in 17 and disappointing results in 5. The latter will be given further study, and the results and findings will be reported later.

The purpose of giving histamine phosphate intravenously was to induce desensitization and amelioration of the symptom complex. The technic follows: One cubic centimeter of solution of histamine phosphate (2.75 mg.) is diluted in 250 cc. of isotonic solution of sodium chloride. This is given drop by drop. Seventy drops are given per minute (2 patients could tolerate only 40 to 50 drops per minute). The blood pressure is taken every ten minutes. Patients responded variously to the administration, but nothing dangerous ever occurred.

The author states that one should give at least two intravenous treatments and in some cases three on alternate days. He doubts the efficacy of the subcutaneous maintenance doses stressed by Horton.

He realizes that some patients with Ménière's syndrome get well without treatment and that others are helped by sedatives, ammonium chloride, a salt-free diet and catheterization of the eustachian tubes, but he offers this method of therapy as an additional line of thought with the inference that histamine administered intravenously might prove to be the most promising medicament described to date. GORDON, Philadelphia.

THERAPY OF DEAFNESS: REPORT OF CASES. LOUIS GUGGENHEIM, Laryngoscope **53**:441 (July) 1943.

This article, in addition to covering the therapy of deafness, emphasizes the part played by the cerebrum in hearing. Audiometry adequately tests the cochlear function but not the cerebral function. Hearing [illegible] holds for pure tones are not the same as those [illegible] speech. Hence the voice test should also be [illegible] According to the Morkovin group, the understanding [illegible] vocal speech is concerned with (1) simple and [illegible] thresholds, (2) sensory organization and ability to [illegible] patterns out of incoming excitations and (3) attaching [illegible] of meaning to sounds. The same men have had [illegible] results by training with the Phipps Unit, which [illegible] the hearing part of the brain.

In the prevention of deafness one should (1) test [illegible] hearing frequently during such diseases as otitis [illegible] (2) give vitamin B complex during diseases that [illegible] affect the eighth nerve, particularly childhood diseases, (3) avoid the use of quinine, (4) protect the ears [illegible] noisy occupations and (5) be careful to provide for [illegible] adequate intake of vitamins, in various diets. Six [illegible] points in the prevention of otosclerosis are given.

Treatment of deafness includes (1) tubal dilation, [illegible] application of radium to the nasopharynx and (3) [illegible] noidectomy. Otosclerosis may be helped by adequate [illegible] amounts of calcium, phosphorus and vitamin B complex. [illegible] Neuropathies of the ear (nerve deafness) may be helped [illegible] by vitamin B complex given for long periods.

Experiments have shown that it takes from one [illegible] two years for the damaged nerve tissue to be repaired. [illegible] In many cases, failure has resulted from too brief [illegible] ministering of these vitamins. Treatment of the cerebral [illegible] part of the hearing mechanism includes a good diet [illegible] with ample vitamins. This gives better health and [illegible] sults in better cerebration. It is pointed out that many [illegible] people perceive the spoken voice better than the printed [illegible] word (audiles), while others (visiles) are just the [illegible] opposite. This helps to show the importance of the [illegible] cerebral part of the hearing mechanism.

HITSCHLER, Philadelphia.

Larynx

USE OF THE STETHOSCOPE IN THE PREVENTION OF "BOILER-MAKERS' LARYNGITIS." L. R. KRAS[illegible], R. J. DE MOTTE and A. C. IVY, J. A. M. A. **12**[illegible] 958 (Dec. 11) 1943.

The authors state that in many industries noise renders it necessary to shout and strain the voice in order to be heard and that this gives rise to many cases of laryngitis which could be prevented by the use of a simple means of communication. They offer the following suggestion:

"The stethoscope is an ideal instrument for this purpose. It does not involve intricate electrical appliances and can be carried about free from line wires. The speaker talks through the bell of the stethoscope. This is best accomplished by cupping the hand about the bell and making contact between the mouth and the hand. The receiver listens through the ear pieces. A very clear communication is thus effected with the tone of the voice at conversational levels amidst loud noises."

GORDON, Philadelphia.

SUBGLOTTIC CANCER. JUSTO M. ALONSO, An. de otorrino-laring. d. Uruguay **12**:91, 1942.

In a series of 750 cases of cancer of the larynx Alonso found 50 cases of true subglottic cancer and 3 of cancer invading the subglottic region.

stresses the importance of early diagnosis of these of subglottic cancer. The criteria for an early nosis are: (1) hoarseness, (2) inspiratory dyspnea, interpreted as asthma, and (3) unilateral paresis ue paralysis of the cords. In patients over 40 years e pain is not a frequent symptom.

e lesion is usually located unilaterally and either iorly or posteriorly (in this site it may be bilateral) may extend to the glottis.

establish a diagnosis a roentgenogram either alone pplemented by tomographic films is a valuable aid is not infallible.

laryngoscopic examination, both indirect and direct, a biopsy of the suspected growth, should be made the symptoms arouse suspicion. Even when the y shows no cancerous change the patient should ept under strict observation for a considerable d and the biopsy repeated at varying intervals.

e treatment is surgical. Irradiation has not pro- d satisfactory results. When the lesion is anterior, so performs laryngofissure and excises at least . of healthy tissue beyond the limits of the tumor. the other hand, when the lesion is posterior or is nsive, spreading to the glottis, he does complete ngectomy.

PERSKY, Philadelphia.

TE LARYNGEAL OBSTRUCTION IN THE ADULT. JUAN CARLOS MUNYO and FEDERICO J. SALVERAGLIO, An. e oto-rino-laring. d. Uruguay **12**:203, 1942.

unyo and Salveraglio discuss the symptoms of e laryngeal obstruction and consider the following as characteristic and diagnostic: (1) descent of larynx during inspiration, (2) suprasternal retrac- and (3) inspiratory dyspnea. Additional symptoms be present. These depend on the cause and the rity of the obstruction. They are disturbances of respiratory rhythm, alterations in the voice, cough, ultatory apnea, venous stasis during the dyspneic s, turgescence of the jugular veins, a paradoxic e and a retraction of the head backward to facilitate thing. Of these supplemental symptoms, one or y may be present.

ome of the provocative factors listed by the authors causing acute laryngeal obstruction are: (1) acute nary infectious disease of the larynx, including e submucous laryngitis and acute phlegmonous ngitis; (2) edema of renal origin; (3) angioneurotic na; (4) iodine medication; (5) erysipelas of the nx; (6) secondary edema; (7) acute arthritis of cricoarytenoid joints (rheumatic); (8) foreign body; croup; (10) nondiphtheritic meningitic membranes; typhoid fever; (12) allergic diseases.

ure depends on (1) early diagnosis, (2) elimination he causative factor if possible, (3) supportive mea- s and (4) in extreme cases tracheotomy.

PERSKY, Philadelphia.

Nose

EVENTION OF EAR AND NASAL SINUS COMPLICATIONS OF THE COMMON COLD. DAVID A. DOLOWITZ, W. E. LOCH, H. L. HAINES, A. T. WARD JR. and K. L. PICKRELL, J. A. M. A. **123**:534 (Oct. 30) 1943.

These authors discuss in moderate detail the bac- ology of the common cold with particular emphasis the pyogenic organisms responsible for the compli- ions that so often occur in the ears and the nasal essory sinuses.

Their method of investigation consisted of a bac- ologic and clinical study of patients arranged in ups, one group being treated by the technic soon be outlined, another being used as a control and a third not participating in the experiment but reporting to the infirmary with complications of the common cold.

Each patient was carefully examined daily with transillumination, with a nasal speculum, especial emphasis being placed on pus or secretions under the anterior ends of the middle turbinate, and a naso-pharyngoscope. Material from the nose, the naso-pharynx and the pharynx was cultured before treatment was begun and daily thereafter until the patient was discharged.

The primary object of the treatment was not to cure common colds, for they were probably initiated by a virus infection, but to prevent the bacterial infections of the sinuses, the ears and the pharynx that so commonly follow colds.

The treatment consisted of spraying the nose and the pharynx with a 2.5 per cent solution of sulfadiazine in ethanolamines solution, the control group receiving the solvent alone; those not participating in the experiment were managed by the usual empiric methods.

Bacteriologic studies show that the sulfadiazine spray does not sterilize the nose and the throat with the occasional exception of beta hemolytic streptococcus infection. Many patients with a red, edematous pharynx and constitutional symptoms due to streptococcic infection are cured within twenty-four hours both bacteriologically and clinically by using only 20 to 25 cc. of the 2.5 per cent sulfadiazine solution as a spray. In order to get this result it is imperative that the treatment begin as soon as possible after the sore throat is noticed, and while the bacteria are still on the surface. The results are not so good if the treatment is begun after the fourth day of the disease. Other strains of streptococci and pneumococci do not disappear or noticeably diminish in numbers in the cultures, but the clinical results suggest that they lose their virulence or their ability to become virulent.

Extension of infection to the sinuses, the ears or the larynx is rare in properly treated patients.

Sensitivity to these medicaments was discussed, though it was not observed in this series of experiments.

The authors, modest in their conclusions, infer that this subject should be given further consideration by medical investigators.

GORDON, Philadelphia.

CHRONIC CORYZA AND VITAMINS. ALFREDO VIDAL FREYRE, An. Soc. puericult. Buenos Aires **8**:160, 1942.

The frequent observation of children who catch cold in spite of every effort to avoid it led to this work. The author used a preparation of vitamin A, 5 drops three times a day, in each nasal fossa.

The results were favorable in 17 cases; 8 patients were cured; 4 were much better; 2 showed fair improvement, and 3 were not benefited.

The author explains the favorable results as due to the protective action of vitamin A on the mucous membrane.

It is clear that before treating chronic coryza one must make the proper diagnosis; it would be ridiculous to treat diphtheria, tuberculosis or syphilis with vitamin A.

GIFFEN, Toledo, Ohio. [AM. J. DIS. CHILD.]

Miscellaneous

MEDICATION BY CHEWING SULFADIAZINE AND OTHER DRUGS INCORPORATED IN A PARAFFIN BASE. JOHN H. ARNETT, Am. J. M. Sc. **205**:6 (Jan.) 1943.

Drugs incorporated in paraffin are slowly released into the saliva when chewed. In the process of chewing

and swallowing they come into intimate contact with the gums, the pharynx and the esophagus. In order to determine the distribution throughout the buccal cavity of the drug being used, ¼ grain (0.016 Gm.) of methylrosaniline chloride U. S. P. (gentian violet) was incorporated in paraffin and given to 13 subjects to chew. It was found that the dye stained the tongue and gingival margins deeply. The tonsils and the posterior part of the pharynx were usually not stained unless the subject chewed and swallowed in the recumbent position with the head lower than the shoulders. Action on the esophagus was taken for granted. The author recommends incorporating 5 grains (0.32 Gm.) of sulfadiazine in a small cube of paraffin having a melting point of 50 to 52 C. It was found that salivary levels of sulfadiazine averaged 66 mg. per hundred cubic centimeters of saliva for the first two hours and the levels of 20 to 25 mg. per hundred cubic centimeters were found after four hours.

DAVISON, Danville, Pa.

KELOIDS: A REVIEW OF THE LITERATURE AND A REPORT OF EIGHTY CASES. JOHN GARB and M. J. STONE, Am. J. Surg. **58**:315 (Dec.) 1942.

Most keloids are caused by known traumas. Syphilis and tuberculosis were not found to be etiologic factors. The etiology is unknown, but the hormonal factor is considered important.

Treatment with roentgen rays or radium before or soon after excision of a keloid does not prevent recurrence of the keloid. Various methods, such as the injection of fibrolysin, cryotherapy (refrigeration), electrolysis and use of ultraviolet rays or Grenz rays, were valueless. Among the surgical methods used but proved ineffective by the authors are scarification with the scalpel, capillary drainage by means of through and through keloidal sutures, and subepidermal excision for purposes of causing primary union.

Roentgen rays and radium are the only effective agents for the treatment of keloids and will cure all the smaller ones except those that are radioresistant. For large keloids and those that are radioresistant, excision in the healthy tissue with the scalpel or the electrosurgical knife is preferred. The healing is promoted by aseptic technic and the use of a stimulating substance, such as ointment of scarlet red N. F. Roentgen therapy should be applied at the first sign of recurrence, but not until then, as irradiation of the involved region before and soon after excision will not prevent the formation of a keloid.

H. MILLER, Philadelphia.

THE LOCAL USE OF THE SULFONAMIDES, GRAMICIDIN (TYROTHRICIN) AND PENICILLIN IN OTOLARYNGOLOGY. JOHN E. BORDLEY, S. J. CROWE, DAVID A. DOLOWITZ and KENNETH L. PICKERELL, Ann. Otol., Rhin. & Laryng. **51**:936 (Dec.) 1942.

The work of Pickerell on the treatment of cutaneous burns has shown that spraying the area with 2.5 per cent sulfadiazine in 8 per cent triethanolamine at least every hour during the first day, every two hours the second day, and so on has been effective and that enough of the drug is absorbed to maintain a high level in the blood. The concentration in the tissues immediately about the sprayed area is about six times the level in the blood. In applying this to otolaryngologic practice the authors found that the mixture sprayed into the nose is readily absorbed and appears in the blood stream, but since not more than 20 cc. is used in any one day, the level in the blood is high. They decided that in the nose and pharynx spray should be used at least eight times a day for first two days and five or six times a day for the two or three days. They report their routine decide that the use of the spray is harmless, is soothing to acutely infected mucosa, controls cough and lessens the incidence of complicating sinusitis in colds. The only contraindication to the use of this spray, they is sensitivity to the drug or the solvent.

The use of gramicidin (a crystalline substance lated from soil bacilli which kills gram-positive mic organisms) is limited because: 1. It is extremely to when injected intravenously, and there is no evide that it can be used against systemic infections. 2. It insoluble in water and is not absorbed by the tissues, it must be applied to a surface in the form of a pow or a suspension in distilled water or oil. It is bacte cidal only when it comes in contact with the bacter and it may give disappointing results in chronic inf tions. 3. It is bactericidal only for gram-positi organisms. Some types of Pneumococcus and Strep coccus are sensitive to gramicidin; others are resista Some strains of hemolytic Staphylococcus aureus the most resistant of all the gram-positive organis Gramicidin is most valuable to the otolaryngolog when used to supplement surgical operation. It grea lessens postoperative discomfort and shortens the peri of hospitalization. It is useful in irrigation of sinus The strength of the suspension of gramicidin must n exceed 1 mg. per cubic centimeter. A stock soluti of 50 mg. per cubic centimeter in 70 per cent alco should be made. If 20 cc. of a suspension is need for a treatment, 0.4 cc. of the alcoholic solution is dra into a tuberculin syringe and added to poppyseed oil distilled water. It should be used at once. The suspension is preferable for packs; the aqueous, f irrigation. For postoperative irrigation it is best reduce the strength to 0.5 mg. per cubic centimeter.

Penicillin cannot as yet be purchased but can be ma in any bacteriologic laboratory by growing the mo Penicillium on suitable mediums. The method described. When the filtrate is made, it should be ke sterile, in a refrigerator, and preferably frozen. It superior to gramicidin in that it is soluble in wat does penetrate tissues and is neither toxic nor irritati to mucous membranes. It is especially effective f staphylococci but is also bactericidal for aerobic a anaerobic types of Streptococcus and Pneumococc Certain strains of these organisms are resistant, ho ever, and will grow freely in broth to which penicill has been added, as will Proteus and some other gra negative organisms.

All three of these preparations are extremely valuab in otolaryngologic practice, but their intelligent u necessitates careful bacteriologic study of each patie

M. V. MILLER, Philadelphia.

SPECIFIC IN VITRO ACTION OF SULFONAMIDE COM POUNDS ON PATHOGENIC ORGANISMS. MILAN NOVA Ann. Otol., Rhin. & Laryng. **52**:161 (March) 19

Novak has come to the conclusion that the sulfo amide compounds act on bacteria mainly by interferi with the enzyme systems of these organisms. Bacter become confused because of the structural similari between the sulfonamide compounds and paraamin benzoic acid, the latter being an accessory growth su stance required for bacterial reproduction. When a ba terium mistakes a molecule of a sulfonamide compou for one of the growth accessory substances, it ceases reproduce, and when reproduction is interrupted, ba

die. Specific action of the sulfonamide compounds emonstrated only in low concentrations of the drugs as are found at the ordinary therapeutic blood ls. In higher concentrations, such as are found in nds following local application of the powdered gs, there is complete inhibition of bacterial multipli- on regardless of the drug used or the species of eria present. Sulfanilamide applied locally in nds is absorbed in about twenty-four hours, so that replacement is necessary. Sulfathiazole and sulfa- ine, being much less soluble, are preferable for l administration when the wound is such that daily ications are inconvenient or undesirable. In cases general systemic infection, in which it is desirable aintain inhibitory concentrations of the drug in all ues, the specific action on various bacteria must be idered. Sulfanilamide is still the drug of choice ases of infection with beta hemolytic streptococci. anaerobic strains are not susceptible to the action ny of the sulfonamide derivatives. The effect on ptococcus viridans is inhibitory in vitro but has significance in such diseases as endocarditis caused his group. Sulfanilamide is useful in trachoma and phogranuloma venereum, which are supposedly ed by viruses, in spite of the fact that virus dis- s are usually not amenable to chemotherapy of this . Brucella infections have also been cleared by anilamide. Sulfathiazole has a specific action on umococci, gonococci, meningococci, staphylococci and enza bacilli in the test tube, but it has no effect in ingococcic or influenzal meningitis as it does not r into the spinal fluid in sufficient concentration. adiazine has the widest range of usefulness, being ctive against all the organisms inhibited by sulfan- ide and sulfathiazole, together with a few additional s, such as Escherichia coli. Sulfaguanidine has a ific local action on the normal intestinal flora. cinyl sulfathiazole has a similar local action specific inst E. coli and intestinal anaerobes as well as on entery organisms. Both the latter drugs are useful peratively in gastrointestinal surgery to minimize sive contamination of the peritoneum during opera- . Sulfapyridine has fallen into disuse because of its erous toxic actions.

M. V. MILLER, Philadelphia.

E PRACTICAL MANAGEMENT OF HEADACHE. ARTHUR W. PROETZ, Ann. Otol., Rhin. & Laryng. **52**:409 (June) 1943.

There is no generally accepted classification of head- es. While the local mechanisms which produce daches are of only two or three types, many remote ditions provoke them by activating these mechan- s. In general it may be said that all headaches t be the result of disturbances transmitted through sensory cranial nerves. Experimental evidence ws that only certain of these are commonly impli- d. There is evidence that pressure, distortion and ical insult are painful only when applied to certain tricted areas of the brain and its coverings. The sitive structures are: the dural arteries, the cerebral eries at the base of the brain, arteries outside the nium, the great venous sinuses and the basal portion the dura itself. Structures said to be relatively in- sitive to pain are: the cranium (including the diploic emissary veins), the parenchyma of the brain, most the dura, most of the pia-arachnoid, the ependymal ng of the ventricles and the choroid plexus.

For clinical purposes Proetz places headaches in ses A, B and C: A includes those having definite monstrable causes, such as a local injury and inflam- tion, an abscess, a tumor, ocular strain and disease, aural, nasal or dental disease, neuritis and neuralgia, distortion or disease of the temporomandibular joint, and remote causes, such as hypertension, cardiac, renal or other organic disease, constipation and gastrointestinal disturbances, organic nervous diseases, anemia, abdominal and pelvic tumors, definitely associated allergy, histamine poisoning, persistent and violent cough, metabolic disturbances, infectious diseases, alcohol, tobacco and drugs. In class B he places headaches with semidemonstrable or suggested causes, such as psyoneurotic disturbances, migraine, fatigue and asthenia, and occupational influences. In class C are headaches with undemonstrable causes. Proper classification is not simple and is sometimes impossible. It is aided by the use of certain "headache charts," copies of which are presented, and also a chart on which is recorded the foods and drugs ingested and some of the more important contacts. After the filling in of the charts, a complete physical and laboratory examination is made. When indicated, various intranasal measures are tried before more or less experimental measures are resorted to. It should be remembered that less than 5 per cent of headaches are referable to the sinuses, no matter what their location, and that there may be extreme distention of the mucosa of a sinus without pain; if the periosteum is involved, however, there probably is pain.

Some believe that when changes of pressure occur in the vascular structures of the brain, the pain is likely to occur during the relaxation and dilatation which follow, and not during the period of increased pressure; consequently Proetz gives his patients ephedrine hydrochloride orally (unless there is hypertension) together with a sedative. Many headaches will be controlled by this alone. If they are affected at all, even though increased, the suspicion of vascular origin is confirmed.

If the ephedrine hydrochloride does not work, and especially if the patient complains of lassitude and fatigue, thyroid is given in place of ephedrine hydrochloride. Thyroid may be better tolerated if thiamine hydrochloride is given at the same time. Patients in whom the thyroid gland is at fault are apt to complain of deep boring or bursting headaches, and there may be sensitivity over the anterior deep temporal artery.

The third experimental measure consists of evacuating the lower bowel at the very onset of the attack, regardless of the patient's statement of the regularity.

Too long periods beween meals can produce typically basilar and occipital headaches. These can be prevented by taking food before they begin, but after they occur, eating will not diminish them.

Drinking of alcohol should be studied, the time taken in relation to eating, sleeping and exercise, the time relation between drink and pain, and the type of drink. Smoking habits are important. Sleeping overlong in a poorly ventilated room may cause headache, as will lack of humidification. Faulty posture produces pain in the occiput and the shoulders. It is well to remember, too, that the same type of headache may be caused at one time by one thing and at another time by another.

M. V. MILLER, Philadelphia.

STUDIES OF PUPILS OF THE PENNSYLVANIA SCHOOL FOR THE DEAF: III. AN ANALYSIS OF SPEECH CHARACTERISTICS IN DEAFENED CHILDREN WITH OBSERVATIONS ON TRAINING METHODS. WALTER HUGHSON, ANTONIO CIOCCO, E. G. WITTING and P. S. LAWRENCE, Child Development **13**:131 (June) 1942.

"Hughson and his associates, working at the Pennsylvania School for the Deaf, have recorded, by electrical transcription, the articulated speech of over 350

deafened children. By means of repeated playing back of the resulting records the detailed characteristics of the speech of each of the children was analyzed and the data presented in statistical terms. It is believed that the method is unique and one that merits further exploration.

"The authors have pointed their analysis so as to bring out with especial clarity the differences resulting from the training histories of the children. It is evident from Hughson's material that auricular training produces a much more favorable result than does the older 'oral' method. The latter fact is especially striking in cases where the method has been started early and continued for as long as 4 to 5 years."

[AUTHORS' SUMMARY]

VITAMIN THERAPY TODAY. ISAAC H. JONES, Laryngoscope **52**:805 (Oct.) 1942.

Much has been learned about nutrition and the vitamins in recent years. The "embryonic approach" to vitamin therapy is important. It is based on the theory that each germ layer of the embryo requires certain specific vitamins for its proper development. After birth and throughout life the tissues derived from this germ layer still continue to demand the same vitamins. Hence valuable clues are given as to what vitamin or vitamins are needed in lesions of this or that tissue.

The author divides the information concerning vitamins into four headings: "reliable," "probable," "possible" and "improbable."

Some of the things mentioned under "reliable" are the following: 1. Of all the vitamins, vitamin B complex is the most apt to be deficient in the usual diet. 2. Foods improperly cooked lose their vitamin content. 3. In a vitamin deficiency it is usually better to prescribe several vitamins than a single one. 4. Dry scaly skin of the external auditory canal may be due to lack of vitamin A. 5. Retrobulbar neuritis may be due to the lack of the vitamin B complex, especially B-1. 6. Transverse fissures of the mouth, eczema of the ear and allied conditions may be relieved by vitamin B-2. 7. In surgical cases with low prothrombin, vitamin K is of value.

Included under "probable" is the fact that vitamin B-1 may relieve fever blisters.

Among the things mentioned under "possible" are the following: 1. The mucosa of the nose and throat may be improved, and hence infection cut down, by vitamin A and, perhaps, vitamins B-1 and B-2. 2. Deafness of cochlear origin may be helped by the vitamin B complex. 3. Vitamin B-1 by its effect on the nerves may lessen tinnitis and strengthen the voice. 4. Epistaxis may be helped by vitamin C.

Histologic studies were made on rats with a moderately low intake of vitamin B complex. No significant changes appeared in the mucosa of the nose or throat, but in the organ of Corti definite degenerative changes were observed.

Although the "embryonic" theory of vitamins seems to be borne out well clinically, depriving pregnant animals of certain vitamins would prove it.

Following this article is one by Jones and Covell giving a comprehensive review of the literature on vitamins in 1941-1942.

HITSCHLER, Philadelphia.

BACTERIAL ALLERGY: OTOLARYNGOLOGICAL ASPECTS. WATT W. EAGLE, South. M. J. **35**:908 (Oct.) 1942.

Eagle stresses the fact that bacterial allergy receives too little attention in medical discussions and in the literature. He calls attention to the complexity of the problem and states that a knowledge of bacteriol of immunology and of biochemical factors in the bl and in various body tissues and secretions is necess to understand the fundamentals of allergy. Bacte allergy is described as being of intrinsic origin and solely a reaction of sensitivity to the toxins of bacte viruses or fungi liberated in the human body by infectious process. The author believes that 15 to per cent of the total number of allergic patients h uncomplicated bacterial allergy.

Cultures of material from sites of infection sh streptococci and staphylococci in predominance, h many other organisms including fungi and fusospi chetal forms are sometimes found. The more comm manifestations of bacterial allergy are asthmatic bro chitis, allergic rhinitis, angioneuroedema, disseminat eczema and urticaria. In making a diagnosis of ba terial allergy Eagle stresses the importance of a positi reaction to an autogenous vaccine after all other c taneous tests have been negative. The history of t case and certain laboratory studies such as roentgen grams of the sinuses and teeth, differential cell coun the Wiltmann and sedimentation tests, and blood calci tests give additional information. Complete eradicati of the infection in conjunction with the administrati of an autogenous vaccine is the recommended treatme Seven brief case reports are included in the discussi

SINGLETON, Dallas, Texas

CHRONIC NASAL DIPHTHERIA CARRIERS: CURE WI SULPHANILAMIDE. JOAN M. BOISSARD and R. M FRY, Lancet **1**:610 (May 23) 1942.

Sulfanilamide powder was administered intranasal to 26 children with heavy bilateral nasal infections wh had had positive cultures (Corynebacterium diphtheri and hemolytic streptococci) for periods ranging fro four to twenty-three weeks. In 24 patients the nas infection was abruptly and permanently ended by th first eight day course of treatment. In the other 2 th result was achieved by a second course.

LANGMANN, New York. [AM. J. DIS. CHILD.]

GRAVE FORMS OF MONOCYTIC ANGINA. PEDRO REGUL and JUAN JOSE LEUNDA, An. de oto-rino-laring. Uruguay **12**:117, 1942.

Regules and Leunda discuss the difficulties of maki a correct diagnosis of acute monocytic lymphangion This clinical entity is important from the standpoi both of differential diagnosis and of prognosis. Cli ically monocytic angina, because of its polymorphis must be differentiated from diphtheria and from hem rhagic diseases of the agranulocytic or the acu leukemic group. In consequence frequent hematolog studies plus repeated serologic tests to determine positive Paul Bunnell reaction must be made. Pro nostically, infectious mononucleosis is usually beni but occasionally a grave form may appear. This characterized by severe hemorrhagic angina and marke asthenia and may involve the central nervous syste Death is not uncommon in these grave forms. Th authors report a case of true infectious mononucleo angina in which severe hemorrhagic lesions were pres in the mouth with extreme toxemia and ultimate in volvement of the bulbar nuclei of the central nervo system. This case terminated fatally as a result respiratory paralysis.

PERSKY, Philadelphia.

Book Reviews

rrinolaringología práctica. By Eliseo V. Segura, M.D., titular professor of the Faculty of Medical Sciences of Buenos Aires, member of the National Academy of Medicine; Georges Canuyt, M.D., titular professor of clinical otorhinolaryngology of the Faculty of Medicine of Strasbourg; Pedro L. Errecart, M.D., titular professor of medical sciences of La Plata and extraordinarius of Buenos Aires, and Atilio Viale del Carril, M.D., chief of clinic and adscript to the professor of otorhinolaryngology of the Faculty of Medical Sciences of Buenos Aires. First edition. Cloth. Pp. 1077, with 382 illustrations. Buenos Aires, Argentina: Libreria Hachette S. A., 1943. (In Spanish.)

the introduction the authors term this excellent a manual especially designed for the medical ent, the general practitioner and the young specialist otorhinolaryngology. It is actually a complete ern volume, with particular emphasis placed on cal manifestations and their interpretations, diags and treatment. In order to facilitate and obtain ore thorough examination, newer methods and inments have been discussed in detail. These include yngoscopy, direct laryngoscopy, visualization of the achian orifice, the use of the antrascope, esophagos-, bronchoscopy and audiometry.

ress has been laid on many interrelated subjects as focal infection, allergy, the pharyngeal manitions of the various leukocytic dysfunctions, the ngeal and tracheal dyspneas of infancy, the physiy of the nasal fossae and sinuses, the newer theories ransmission and reception of sound waves, osteitis he petrous pyramid, acute meningitis, traumatism he ear and fractures of the nose.

herapy is discussed logically, with stress on the ors producing the diseased conditions and the applion of curative or eliminative procedures. Where surgical intervention is indicated the technic is rly and simply described, often augmented by clearillustrations.

he book is in a good, easily read type, printed on d paper and merits translation.

ty Years in Medicine. By Joseph C. Beck, M.D. Price $3. Pp. 335. Chicago: McDonough and Company, 1943.

his book is an outgrowth of collected papers, clips and pictures of Dr. Beck and his many friends. was urged to write it by so many that he set about task and in his usual keen perceptive style presents with a text of 335 pages divided into three parts as ows: part 1 which has the title "Medical Masters," 2 entitled "My Life and Basic Information" and 3 "Some Otolaryngological Friends."

he book is essentially a historical narrative being with Dr. Beck's embracing the otolaryngologic specialty in Chicago and radiating therefrom throughout the United States, with full comments on experiences in foreign clinics and in teaching. Over 350 eminent otolaryngologists in America are briefly but adequately documented in a clear vivid style that breathes the very soul of Dr. Beck, and it is evident how much he loved and cherished his friends, associates, assistants and acquaintances.

Dr. Beck was a great thinker. Besides his many otolaryngologic activities, his work included plastic surgery, treatment of neoplastic diseases and descriptions of gross and histopathologic studies of specimens. The reader will find much food for thought throughout the pages, for there is much philosophy, analysis and resynthesis.

And now that he has been called to the Great Beyond, it is for us the living to recall the ethics and the character of Dr. Beck by which he caused otolaryngologic light to shine on our specialty, thereby fulfilling that command: "Let your light so shine before men, that they may see your good works, and glorify your Father which is in heaven" (Matthew 5:16).

Sordera. By Pedro L. Errecart, M.D., titular professor of the Faculty of the Medical Sciences of La Plata, professor extraordinary to the Faculty of Medical Sciences of Buenos Aires, honorary professor of the Faculty of Medicine of Rosario. First edition. Paper. Pp. 255, with 37 illustrations. Buenos Aires, Argentina: Libreria Hachette S. A., 1943. (In Spanish.)

This is an excellent monograph. The author has given a clearcut discussion of the complicated problem of deafness and has presented the present day acceptance of causes, diagnostic criteria and therapeutic principles in a simple, easily understood manner. He has subdivided the subject into chapters dealing with (1) middle ear deafness, (2) otosclerosis, (3) progressive labyrinthitis, (4) congenital labyrinthitis, (5) deafmutism, (6) occupational deafness, (7) senile deafness, (8) toxic neuritis of the acoustic nerve, (9) syphilitic neurolabyrinthitis and (10) Ménière's disease.

The chapter on otosclerosis is noteworthy. The author includes all the modern concepts of the possible etiologic factors, and his discussion of treatment utilizes these factors with a frank evaluation of the results of therapy. He gives a detailed discussion of both the surgical principles and the surgical technic. The Lempert procedure with its recent modification (fenestra nov-ovalis) is given its proper evaluation.

The author has streamlined each chapter and so has eliminated many antiquated beliefs. Nevertheless, it is complete and modern in all its viewpoints. This monograph merits translation and is a worth while addition to the otologist's table.

News and Comment

SSELBERRY AWARD OF THE AMERICAN LARYNGOLOGICAL ASSOCIATION

A sum of money having accrued from the Casselberry nd of the American Laryngological Association, a prize will be offered in 1944 for papers on original investigation in the art and science of laryngology or rhinology. These must be in the hands of the secretary, Dr. Arthur W. Proetz, 1010 Beaumont Building, St. Louis 8, Mo., before March 1, 1944.

Directory of Otolaryngologic Societies *

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Claude C. Cody, 1304 Walker Ave., Houston, Texas.
Secretary: Dr. Louis H. Clerf, 1530 Locust St., Philadelphia.
Place: Chicago. Time: June 12-16, 1944.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Lawrence T. Post, 508 N. Grand Blvd., St. Louis, Mo.
President-Elect: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Executive Secretary: Dr. William L. Benedict, Mayo Clinic, Rochester, Minn.

American Broncho-Esophagological Association

President: Dr. Robert L. Moorhead, 125 Ramsen St., Brooklyn.
Secretary: Dr. Paul Holinger, 700 N. Michigan Ave., Chicago.
Place: New York. Time: June 6, 1944.

American Laryngological Association

President: Dr. Charles J. Imperatori, 108 E. 38th St., New York.
Secretary: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis.
Place: New York. Time: June 7-8, 1944.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. H. Marshall Taylor, 111 W. Adams, Jacksonville, Fla.
Secretary: Dr. C. Stewart Nash, 708 Medical Bldg., Rochester, N. Y.
Place: New York. Time: June 9-10, 1944.

SECTIONS:

Eastern.—Vice President: Dr. Westley M. Hunt, 5th Ave., New York 21.
Place: New York. Time: Jan. 14, 1944.
Southern.—Vice President: Dr. William C. Warren, 478 Peachtree St. N. E., Atlanta, Ga.
Place: Atlanta, Ga. Time: Jan. 8, 1944.
Middle.—Vice President: Dr. Fred W. Dixon, 9th St., Cleveland.
Place: Cleveland. Time: Jan. 12, 1944.
Western.—Vice President: Dr. Simon Jesberg, Lucas Ave., Los Angeles.
Place: Los Angeles. Time: Jan. 22-23, 1944.

American Otological Society

President: Dr. Wesley C. Bowers, 17 E. 61st, New York 21.
Secretary: Dr. Isidore Friesner, 101 E. 73d St., York.
Place: New York. Time: June 5-6, 1944.

* Secretaries of societies are requested to furnish information necessary to keep this list up to date.

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